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# A revision of the leafhopper tribe Paraboloponini (Hemiptera: Cicadellidae: Selenocephalinae) in the Indian subcontinent

C. A. VIRAKTAMATH

Department of Entomology, University of Agricultural Sciences, GKVK, Bangalore  
560 065, India

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**SYNOPSIS.** The Paraboloponini (Cicadellidae: Selenocephalinae) of the Indian subcontinent (Pakistan, India, Nepal, Sri Lanka, Bangladesh, Bhutan and Burma) are revised. Thirteen genera (two new) and 37 species (21 new) of the tribe occur in the study area. All taxa are keyed, described and illustrated. The following new taxa are established: *Indokutara*, *I. conica*, *Kotabala*, *K. adivayyai*, *Carvaka*, *C. clava*, *C. compressa*, *C. confusa*, *C. elongata*, *C. girijae*, *C. kumari*, *C. nielsoni*, *C. pruthii*, *C. sinuata*, *C. synavei*, *C. wellingtoni*, *Divus*, *D. samanus*, *Kutara*, *K. brevipalata*, *K. crypta*, *K. striata*, *K. trifida*, *Megabyzus*, *M. ganeshai*, *M. indicus* and *M. jogensis*. *Selenocephalus brunneus* Pruthi is synonymized with *Carvaka modesta*.

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## INTRODUCTION

Paraboloponini leafhoppers form a small group treated either as a distinct subfamily of Cicadellidae or as a tribe of the subfamily Selenocephalinae (Zhang and Webb, 1996). These leafhoppers are found in the Old World tropics and have been recently revised by Linnavuori (1978) for the Afrotropical region and by Webb (1981) and Zhang & Webb (1996) for the Asian, Australasian and Pacific regions. Ghauri and Viraktamath (1987) described two genera, *Sohipona* and *Shivapona*, with six species from the present study area; these are now placed in the subfamily Deltocephalinae, tribe Grypotini (Zhang and Webb, 1996) and are not considered further here. The genera *Dryadomorpha* Kirkaldy, *Parabolopona* Matsumura, *Parohinka* Webb, *Omanella* Merino and *Roxasella* Merino and included species, *D. pallida* Kirkaldy, *P. longiseta* (Melichar) and *O. johnsoni* Merino, also from the Indian subcontinent, have been well described and illustrated by Webb (1981) and Zhang and Webb (1996) and are thus only dealt with briefly here. The remaining genera and species are fully described together with keys and detailed figures to all taxa.

The Paraboloponini are medium sized to large leafhoppers (4.5–8.5 mm long), with the head triangularly produced or rounded with transverse anterior striations and longitudinal striations on the vertex. The antennae are very long, arising near the dorsal corners in deep pits, the pronotum is transversely striate. The forewing venation is complete. The hind femoral spinulation formula is 2+2+1, 2+1+1 or 2+1+0. The male genitalia are characterised by: male pygofer lobe with several long, spine-like setae; subgenital plates with fine hair-like setae; connective Y-shaped, arms short; aedeagus usually symmetrical, sometimes fused with connective. The basal apodemes of the male abdomen are reduced.

These leafhoppers are usually collected on annual herbs, shrubs and trees. *Dryadomorpha pallida* has been collected on *Ziziphus mauritiana* (Rhamnaceae), and *Favintiga camphorae* (Matsumura) has been collected on *Cinnamomum camphorae* (Lauraceae), *Rapanea* sp. (Myrsinaceae), *Reynoldsia* sp. (Araliaceae) and *Weinmannia parviflora* (Cunoniaceae). During the present studies, paraboloponines were collected generally in dry deciduous forests in India. *Parohinka longiseta* was collected on *Ziziphus mauritiana* and *Megabyzus indicus* was collected on *Tephrosia purpurea* (Leguminosae) and grasses.

## DEPOSITORIES

The following abbreviations are used for institutions from which specimens were borrowed for this study

and where type specimens of the new taxa will be deposited.

BMNH	The Natural History Museum, London, United Kingdom
BPBM	Bernice P. Bishop Museum, Honolulu, Hawaii, USA
FRI	Forest Research Institute, Dehradun, India
IRSNB	Institut Royal des Sciences Naturelles de Belgique, Belgium
MMB	Moravian Museum, Brno, Czechoslovakia
MNHU	Museum für Naturkunde Der Humboldt Universität zu Berlin, Germany
NMNH	National Museum of Natural History, Washington, DC, USA
NPC	National Pusa Collection, Indian Agricultural Research Institute, New Delhi, India
NRS	Naturhistoriska Riksmuseet, Stockholm, Sweden
UAS	University of Agricultural Sciences, Bangalore, India
ZMC	Zoologisk Museum, Copenhagen, Denmark
ZSI	Zoological Survey of India, Calcutta, India

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## REVIEW OF GENERA AND SPECIES

### Checklist of *Paraboloponini* from the Indian sub-continent\*

<b>BHATIA</b> Distant, 1908	
<i>distanti</i> Zhang and Webb, 1996	Sri Lanka
<i>olivacea</i> (Melichar, 1903) ( <i>Eutettix</i> ?)	Sri Lanka
<b>CARVAKA</b> Distant, 1918	
<i>clava</i> sp. n.	India: Karnataka
<i>compressa</i> sp. n.	India: Tamil Nadu
<i>confusa</i> sp. n.	India: Kerala
<i>dolens</i> (Melichar, 1903) ( <i>Selenocephalus</i> )	Sri Lanka
<i>elongata</i> sp. n.	India: Karnataka, Kerala
<i>girijae</i> sp. n.	India: Karnataka
<i>kumari</i> sp. n.	India: Karnataka
<i>modesta</i> Distant, 1918	India: Tamil Nadu
<i>brunneus</i> (Pruthi, 1930) ( <i>Selenocephalus</i> ), <b>syn. n.</b>	
<i>nielsoni</i> sp. n.	India: Karnataka, Tamil Nadu
<i>ochrophora</i> Distant, 1918	India: Tamil Nadu
<i>picturata</i> Distant, 1918	India: Tamil Nadu
<i>pruthii</i> sp. n.	India: Karnataka
<i>sinuata</i> sp. n.	India: Karnataka, Kerala, Tamil Nadu
<i>synavei</i> sp. n.	India: Tamil Nadu
<i>thoracica</i> Distant, 1918	India: Tamil Nadu
<i>wellingtoni</i> sp. n.	India: Karnataka, Tamil Nadu

(\*Pakistan, India, Sri Lanka, Nepal, Bhutan, Bangladesh, Burma)



- DIVUS** Distant, 1908  
*bipunctatus* (Melichar, 1903) Sri Lanka  
*samanus* sp. n. India: Tamil Nadu
- DRYADOMORPHA** Kirkaldy, 1906  
[For a full generic and specific synonymy see Webb, 1981.]  
*PAGANALIA* Distant, 1917  
*ZIZYPHOIDES* Distant, 1918  
*RHOMBOPSIS* Haupt, 1927  
*RHOMBOPSANA* Metcalf, 1967  
*pallida* Kirkaldy, 1904 S. Palearctic/Old World tropics  
*indicus* Distant, 1918  
*viridis* Singh-Pruthi, 1930  
*chatterjeei* Singh-Pruthi, 1934
- INDOKUTARA** gen. n.  
*conica* sp. n. India: Karnataka
- KOTABALA** gen. n.  
*adiveyyai* sp. n. India: Karnataka
- KUTARA** Distant, 1908  
*breviplata* sp. n. India: Mizoram  
*brunnescens* Distant, 1908 India: Karnataka; Sri Lanka  
*crypta* sp. n. Burma  
*striata* sp. n. India: Karnataka, Kerala, Tamil Nadu  
*transversa* Zhang and Webb, 1996 Sri Lanka  
*trifida* sp. n. India: West Bengal
- MEGABYZUS** Distant, 1908  
*ganeshai* sp. n. India: Karnataka  
*indicus* sp. n. India: Karnataka, Himachal Pradesh  
*jogensis* sp. n. India: Karnataka  
*signandus* Distant, 1908 Sri Lanka
- NAKULA** Distant, 1918  
*multicolor* Distant, 1918 Burma; Thailand
- OMANELLA** Merino, 1936  
*johnsoni* Merino, 1936 Burma; Sri Lanka
- PARABOLOPONA** Matsumura, 1912  
undescribed sp. Nepal
- PAROHINKA** Webb, 1981  
*longiseta* (Melichar, 1914) (*Muirella*) Indo-Australian
- ROXASELLA** Merino, 1936  
*egregia* (Stål, 1864) Burma

- Latero-frontal sutures on face present ..... 5
- 4 Head and thorax yellow with brown spots; head of near uniform length, fore-margin angularly rounded with 3 to 5 carinae ..... *Omanella* (p.173)
- Head and thorax without brown spots; head produced medially; fore-margin with 2 carinae, foliaceous ..... *Parabolopona* (p.175)
- 5 Vertex less than twice as wide between eyes as long; face longer than wide (including eyes); hind femoral spinulation 2+1+1 ..... 6
- Vertex more than twice as wide between eyes as long; face shorter than wide (including eyes); hind femoral spinulation 2+2+1 ..... 7
- 6 Vertex without pale patches; female genitalia with posterior margin of pregenital sternum with a small protuberance each side of midline (Fig. 303); dorsal margin of second valvulae with an anterior prominence (Fig. 304); aedeagus symmetrical (Fig. 302) ..... *Dryadomorpha* (p.174)
- Vertex with pale patches; female genitalia with posterior pregenital sternum without protuberance each side of midline (Fig. 315); dorsal margin of second valvulae without an anterior prominence (Fig. 316); aedeagus asymmetrical (Figs 311–314) ..... *Parohinka* (p.174)
- 7 Aedeagus and connective fused ..... 8
- Aedeagus and connective articulated ..... 9
- 8 Aedeagal shaft with a ventral plate-like prolongation of connective, with caudolateral process (Figs 260, 261); apophysis of style forked (Fig. 259); subgenital plate with membranous caudal lobe (Fig. 257) ..... *Kotabala* (p.171)
- Aedeagal shaft without a ventral plate-like prolongation of connective; apophysis of style simple, not forked (Fig. 271); subgenital plate without membranous caudal lobe ..... *Indokutara* (p.172)
- 9 Male pygofer with truncate caudal margin; ventrocaudal margin angularly produced (Fig. 245); preatrium of aedeagus with a paired process (Sri Lanka) ..... *Bhatia* (p.170)
- Male pygofer either rounded or conically produced without any process; preatrium of aedeagus without a process or with an unpaired process arising from an intermediate sclerite ..... 10
- 10 Male genitalia with an intermediate sclerite articulated both with connective and aedeagus (Fig. 189) ..... 11
- Male genitalia without an intermediate sclerite ..... 12
- 11 Aedeagus with a pair of basal processes on shaft (Figs 181, 189) ..... *Divus* (p.166)
- Aedeagus without a pair of basal processes on shaft .... *Carvaka* (in part) (p.158)
- 12 Claval veins on forewing connected by cross vein at least on one side (Figs 21, 194) ..... 13

## Key to genera of Paraboloponini from the Indian subcontinent

- 1 Head, thorax and margins of forewings marked with orange ..... 2
- Not marked as above ..... 3
- 2 Vertex very short medially than next to eyes (Fig.281); antennae below mid-height of eye in facial view (Fig.282) ..... *Nakula* (p.173)
- Vertex longer medially than next to eyes (Fig.290); antennae not as above (Fig. 291) ..... *Roxasella* (p.174)
- 3 Latero-frontal sutures on face absent ..... 4



- Claval veins on forewing not connected by a cross vein (Fig. 63) ..... *Carvaka* (in part) (p.158)
- 13 Predominantly green species; vertex medially longer than next to eyes, not deeply sulcate transversely, pedicel of antenna ochraceous; male subgenital plate with 2–4 long setae ..... *Megabyzus* (p.156)
- Predominantly brown; median length of vertex shorter than next to eyes, deeply transversely sulcate; pedicel of antennae brown; male subgenital plate without long setae ..... *Kutara* (p.167)

## MEGABYZUS Distant, 1908

*Megabyzus* Distant, 1908: 294. Type species: *Megabyzus signandus* Distant, by original designation.

**DESCRIPTION.** Greenish ochraceous. Apices of claval veins, apex of clavus, claval area and apical area of forewing with irregular black or dark brown patches. Head wider than pronotum, anterior margin angularly or arcuately rounded in profile, transversely striate to carinate; ocelli on margin, placed a distance greater than own diameter from adjacent eye, partially visible from above. Vertex triangularly produced, median length 1.7–1.8× length next to eyes; with a transverse impression before apex; finely longitudinally striate. Face 1.2–1.4× wider than long. Frontoclypeus strongly widened dorsally. Clypellus 1.45–1.70× longer than greatest width, constricted slightly beyond clypoclypellar sulcus, widest apically. Lora large. Pronotum approximately twice as wide as long, sides moderately long, feebly carinate; finely transversely striate, shagreen and smooth anteriorly. Scutellum slightly longer than pronotum, shagreen, obscurely rugose posteriorly. Forewing with three subapical cells, inner subapical cell open behind, five apical cells. Fore femur with a series of 12 to 13 setae distally on anterior surface; hind femur with apical setal formula 2+2+1, hind tibial spinulation  $R_1$  19±2,  $R_2$  11±1,  $R_3$  15±1, hind basitarsomere with 4 platellae.

Anterior margin of male pygofer straight with variably developed apodeme, dorsocaudal area obliquely darkly pigmented, pygofer lobe with long setae. Valve transverse, strap-like. Subgenital plate moderately long, twice as long as wide at base, triangular, apical region digitate, lightly sclerotized, apex darkly pigmented, two to four long setae at midlength along lateral margin in a row in addition to short setae. Style moderately long with well developed preapical lobe, apophysis crenulate, outer apical angle prolonged, foot-like. Connective Y-shaped, stem twice as long as arms, broadened caudally. Aedeagus with shaft elongate, curved caudo-dorsally, tapered to apex, terminated by a pair of forked or unforked processes, gonopore small, apical on posterior surface; dorsal apodeme well developed, elongate.

Female seventh sternum broadly produced posteriorly and narrowed with a protuberance on each side of median notch or bilobed. Second pair of valvulae with dorsal teeth extending half the length.

**REMARKS.** This genus is similar to *Parabolopona* and *Favintiga* Webb in having the lateral margins of the pronotum moderately long and carinate, and the hind femur setal formula 2+2+1. It differs from *Parabolopona* in having a longitudinally striated rather than shagreen vertex and from *Favintiga* in the absence of a process to the connective and a stouter female second valvula. The subgenital plate in *Megabyzus* has 2–6 elongate setae which are not found in the other two genera.

## Key to species of *Megabyzus*

- 1 Aedeagus with apical process forked (Figs 7, 19, 28, 29); forewing with several dark brown spots on clavus in addition to those at apex of clavus and claval veins (Figs 3, 14, 21) ..... 2
- Aedeagus with apical process unforked (Fig. 40); forewing with dark brown spots confined only to apex of clavus and claval veins (Fig. 35) (India: Karnataka, Himachal Pradesh) ..... *indicus* (p. 158)
- 2 Aedeagus with dorsal fork of apical process slender, shorter than anteriorly directed process (Fig. 28) (India: Karnataka) ..... *jogensis* (p. 157)
- Aedeagus with dorsal fork of apical process longer than anteriorly directed process (Figs 7, 19) ..... 3
- 3 Aedeagus with base of shaft not prominently bulbous; forks of apical process held at obtuse angle forming a uniform curve in lateral aspect (Fig. 19) (India: Karnataka) ..... *ganeshai* (p. 157)
- Aedeagus with base of shaft bulbous; forks of apical process held at acute angle (Figs 7, 8) (Sri Lanka) ..... *signandus* (p.156)

## *Megabyzus signandus* Distant

(Figs 1–11)

*Megabyzus signandus* Distant, 1908: 295; Zhang & Webb, 1996, Figs 44, 479 (habitus). Holotype ♀, SRI LANKA (BMNH) [examined].

**DESCRIPTION.** Male 5.4 mm long, 1.65 mm wide across eyes. Female 5.8 mm long, 1.82 mm wide across eyes. Ochraceous. Ocelli reddish. Apical two-thirds of clypellus fuscous. Eyes black. A few scattered irregular spots on clavus and apical part of fore wing, veins enclosing apical cells, a spot on m-cu<sub>2</sub> cross vein and another on costa blackish brown. Legs with coxa and femora dark fuscous, fore tibiae fumose, streaked with fuscous, tibiae and tarsi ochraceous with brown spots at base of spines. Anterior margin of head para-



bolic with four marginal carinae. Ocelli on margin of crown placed at a distance greater than own diameter from adjacent eye. Crown of vertex slightly depressed beyond middle with longitudinal rugulae becoming more oblique towards lateral area. Face shagreened. Lora not attaining apex of clypellus.

Male pygofer lobe caudally rounded, clothed with minute asperites, apical one-third black; with numerous setae. Subgenital plate with two rows of stout setae totalling six, apical extension membranous, with black tipped apex. Style robust, anterior 0.75 with well developed subapical lobe, apophysis sculptured, outer apical angle laterally drawn out. Connective with stem twice as long as arms. Dorsal apodeme of aedeagus well developed, half as long as shaft. Aedeagal shaft with a swollen ventral margin at basal one-third, then narrowed, terminated by a pair of elongate forked processes, the more dorsal process longer, abruptly curved ventrally at midlength, ventral fork anteriorly directed.

Female seventh sternum half as long as wide, medially produced with trilobed median area. Second valvulae with 12 smooth teeth on cutting edge.

#### MATERIAL EXAMINED (3 specimens)

Holotype ♀, **Sri Lanka**: Anuradhapura ['a. pura'], xii.1904 ['12-04'] (BMNH).

Other material: **Sri Lanka**: 1♂, 1♀, Peradeniya, iii.1911 (BMNH).

REMARKS. *M. signandus* has more slender and elongate aedeagal apical processes than other species included in the genus. *M. signandus*, *ganeshai* and *jogensis* form a closely related group differing from *indicus* in having the aedeagus with forked apical processes and the connective Y-shaped rather than X-shaped.

#### *Megabyzus ganeshai* sp. n.

(Figs 12-20)

DESCRIPTION. Male 5.7 mm to 5.9 mm long, 1.7 mm wide across eyes. Coloration and external characters similar to *signandus* but blackish brown spots on forewing less extensive and legs yellowish with pale brown spots at bases of hind tibial spines. A teneral male from Kollur has a red stripe on either side of median line traversing head and pronotum. Vertex about half as long as width between eyes, pronotum twice as wide as long, shorter than scutellum. Anterior rim of vertex with three to four rugae.

Male genitalia similar to *signandus* but pygofer with caudal lobe more acutely rounded, black pigmented along caudo-dorsal and dorsal border. Subgenital plate twice as long as basal width with two long stout setae, apex black pigmented. Style apophysis more laterally curved. Connective with short arms and longer caudally widened stem of 'Y'. Dorsal

apodeme of aedeagus one-third as long as shaft, basal one-third of shaft directed caudally and caudo-dorsally, shaft terminated by a pair of forked processes, forks held at obtuse angle forming an even curve in lateral aspect, the more dorsal fork bifid apically.

#### MATERIAL EXAMINED (3 specimens)

Holotype ♂, **India**: Karnataka, Mudigere, 2.vi.1978 (*Viraktamath*) (UAS).

Paratypes: **India**: 1♂, data as holotype but 21.v.1976 (*Mallik*); 1♂, Kollur, 11.i.1984 (*Viraktamath*) (BMNH, UAS).

REMARKS. *M. ganeshai* differs from both *signandus* and *jogensis* in the shape of the aedeagal processes, with the forks forming an arc; the base of the shaft is not so bulbous.

#### *Megabyzus jogensis* sp. n.

(Figs 21-31)

DESCRIPTION. Male 5.76 (5.40-6.10) mm long, 1.75 (1.70-1.80) mm wide across eyes. Female 6.20 (6.00-6.50) mm long, 1.92 (1.90-2.00) mm wide across eyes. Coloration and external characters similar to *ganeshai* but frontoclypeus flat, anterior rim of head with three rugae.

Male pygofer with dorsal border broadly dark brown widening caudally. Subgenital plate slightly more than twice as long as broad, with 2-4 long stout setae on outer margin, apical quarter of caudal extension black. Style as in *signandus*, with scale-like sculpturing along inner length of apophysis. Connective with stem broadened posteriorly. Aedeagus slightly variable with respect to shape, curvature and relative length of apical processes within the type series. Dorsal apodeme either slender (Fig. 29) or stouter (Fig. 28), half as long as aedeagal shaft, base of shaft swollen, gradually narrowed caudally, terminated by a pair of forked processes; dorsal fork slender 0.4 to 0.62 as long as anteriorly directed process, latter stouter with a triangular process at basal 0.25.

#### MATERIAL EXAMINED (9 specimens)

Holotype ♂, **India**: Karnataka: Jog Falls, 9.v.1976 (*Mallik*) BM 13 (UAS).

Paratypes: **India**: Karnataka: 1♂, 1♀, Jog Falls, 17.xi.1976 (*Viraktamath*); 3♂, 1♀, Kodyamale (nr. Bantval), 16.i.1984 (*Viraktamath*); 1♀, 64 Km E Kollegal, 9.viii.1977 (*Viraktamath*); 1♀, Dharmasthala, 25.i.1984 (*Viraktamath*) (BMNH, IARI, UAS, NMNH).

REMARKS. Slight variation occurs in specimens of this species from Jog Falls in the male pygofer lobe and aedeagal processes. It differs from both *signandus*



and *ganeshai* in having the aedeagus with a shorter and more slender dorsal fork of the apical process.

### *Megabyzus indicus* sp. n.

(Figs 32–43)

**DESCRIPTION.** Male 5.60 (5.50–5.70) mm long, 1.72 (1.70–1.77) mm wide across eyes. Female 6.20 mm long, 1.90 (1.87–1.95) mm wide across eyes. Greenish yellow. A spot at apex of each claval vein, apex of clavus, veins bordering apical cells especially near anal margin marked with blackish brown. Anterior margin of head not as acutely angled as in *signandus*, but rounded with seven transverse carinae, crown of vertex with a transverse furrow before apex, frontoclypeus more tumid compared with *signandus*. Pronotum transversely striate.

Male pygofer with caudal lobe more acutely rounded. Subgenital plate twice as long as basal width with four marginal stout elongate setae. Connective X-shaped with caudal arms longer than anterior arms. Apophysis of style curved laterally with sculpturing on surface. Dorsal apodeme of aedeagus well developed, two-thirds as long as shaft, shaft narrowed distally in apical quarter with a pair of antero-laterally directed apical processes, shaft in ventral view slightly widened in apical three-quarters.

Female seventh sternum more than half as long as wide. Hind margin broadly medially produced with a median notch (Fig. 42). Second pair of valvulae with teeth on cutting edge not extending to apex.

#### **MATERIAL EXAMINED** (11 specimens)

Holotype ♂, **India:** Karnataka: Bangalore, Banneraghatta, 9.viii.1979 (*Dworakowska*) (UAS).

Paratypes: **India:** 2♂, 4♀, data as holotype; 3♂, 1♀, **India:** Himachal Pradesh: 5 km. N Kalka, 2.x.1980 (*Viraktamath*) (BMNH, IARI, UAS, NMNH).

**REMARKS.** *M. indicus* is unique among the species of *Megabyzus* in having less extensive dark brown markings on the clavus, the head angularly rounded in profile, the connective X-shaped, the caudal pygofer lobe angularly rounded and the aedeagus with the shaft laterally dilated at two-thirds apically and with the apical processes not forked.

### **CARVAKA Distant, 1918**

*Carvaka* Distant, 1918: 40; Zhang & Webb, 1996: 13.

Type species: *Carvaka picturata* Distant, by original designation.

**DESCRIPTION.** Ochraceous to brownish. Vertex often with transverse dark brown short stripes or with round black spots. Forewings with small dark brown spots on apex of claval veins, cross veins, and clavus. Head wider than pronotum; anterior margin with a

series of transverse rugae; ocelli on margin, placed a distance greater than their diameter from adjacent eye, visible from above; vertex medially slightly longer than next to eye, sides convex, with an anterior transverse depression, medially longitudinally, laterally obliquely striate. Face wider than long, shagreen, in profile slightly convex in dorsal half then rather straight; frontoclypeus medially long, narrow; lateral margins constricted near antennae; clypellus longer than wide; wider apically than at base. Anterior tentorial arms L-shaped, with a protuberance at the junction of the two arms (Fig. 99). Pronotum about twice as wide as long, transversely striate, shagreen anteriorly, lateral margin rather short, carinate. Scutellum slightly longer than pronotum, obscurely rugulose in posterior half. Forewing with three subapical cells, inner subapical cell open behind or closed (*picturata* and *thoracica*). Hind femoral spinulation 2+2+1. Hind tibial spinulation  $R_1$  22±2,  $R_2$  11±1,  $R_3$  20±1. Hind basitarsus with three platellae.

Male genitalia with anterior margin without or with a small apodeme; pygofer lobe usually conically produced caudally, with several macrosetae, ventral margin roundly expanded; valve strap-like, subgenital plate elongate, triangular with inner marginal sclerotized area; with a few hair-like setae. Style with slender apophysis, its caudolateral angle produced, often beak-like. Connective Y-shaped, articulated with aedeagus or with an interconnecting sclerite with a slender (Fig. 77) or stouter process (Figs 58, 68) or without process (Figs 130, 154). Aedeagus with well developed dorsal apodeme, shaft with apical or subapical processes of varying length.

Female genitalia with second valvulae with a basal prominence; dorsal teeth moderately thick with serrated margin.

**REMARKS.** *Carvaka* is related to *Divus* and some species have similar coloration to those of *Divus*. It differs however, in lacking a pair of basal aedeagal processes to the shaft. Zhang and Webb (1996) considered this genus close to *Hybrasil* Kirkaldy from which it also differs in having a ventrally expanded margin of the male pygofer.

Three species groups are here recognised in the genus.

- (i) *picturata* group: *modesta* Distant, *ochrophora* Distant, *picturata* Distant and *thoracica* Distant. This group, which is closest to the genus *Divus*, is characterized by having a sclerite between the aedeagus and connective with an elongate process. *C. contempta* (Kirkaldy) from Australia appears also to belong to this group (Zhang & Webb, 1996).
- (ii) *clava* group: *clava*, *nielsoni* and *sinuata*. This group is characterized by the absence of a sclerite between the aedeagus and connective and the



preatrium being well developed and ventrocaudally produced into a process.

iii) *pruthii* group: *compressa*, *elongata*, *girijae*, *kumari*, *pruthii*, *synavei*, *wellingtoni* and the Taiwanese *formosana* (Matsumura). This group is characterized by either lacking a sclerite between the aedeagus and connective or having a rudimentary sclerite as in *wellingtoni* and *synavei*. The aedeagus is either compressed strongly laterally or cylindrical with apical or subapical processes and the preatrium is not produced ventrocaudally.

*C. dolens* (Melichar) which is known only from a female is not placed in any of the above groups.

Species of the *pruthii* group, especially *pruthii*, *girijae*, *elongata* and *kumari* resemble externally *Divus bipunctatus* (Melichar) in coloration whereas *ochrophora* and *modesta* of the *picturata* group externally resemble *D. samanus*.

Key to species of *Carvaka* from the Indian sub-continent

(*C. dolens*, known only from the female, is not included in the key)

- 1 Head with a median black spot connected with lateral transverse short or large stripes (Figs 44, 50); fore wing with two m-cu cross veins (Fig. 47) ..... 2
- Head with lateral transverse stripe(s) (Figs 60, 72, 80) or with two black spots (Fig. 111); fore wing with one m-cu cross vein (Fig. 63) ..... 3
- 2 Hind margin of female seventh sternum medially strongly produced (Fig. 52); male genitalia as in Figs 54–59 ..... *thoracia* (p. 160)
- Hind margin of female seventh sternum medially slightly produced (Fig. 48) (male unknown) ..... *picturata* (p.159)
- 3 Aedeagus with ventral articulated appendage between connective and aedeagus (Figs 68, 77) ..... 4
- Aedeagus without a ventral articulated appendage between connective and aedeagus (Figs 85, 117, 130) ... 5
- 4 Aedeagus with shaft widened at midlength (Fig. 68); apical process slender, one-third length of shaft, ventral appendage stout ..... *ochrophora* (p.160)
- Aedeagus with shaft gradually narrowed caudally, apical processes 0.5 length of shaft; ventral appendage slender (Fig.77) ..... *modesta* (p.161)
- 5 Aedeagus with preatrium ventrally produced (Figs 85, 96) ..... 6
- Aedeagus with preatrium not ventrally produced (Figs 117, 130) ..... 8
- 6 Aedeagus with apical processes of shaft short, with rounded apices, preatrium broadly produced ventrally,

- preatrial process narrower than atrium (Figs 96, 97) ..... *clava* (p.162)
- Aedeagus with longer, distally narrowed processes; preatrial process broader than shaft at base (Figs 86, 106) ..... 7
- 7 Aedeagal shaft with a basal protuberance; apical processes four times as long as width of apex in lateral aspect (Fig. 86) ..... *sinuata* (p.161)
- Aedeagal shaft without basal protuberance, apical processes 1.5 times as long as width of shaft at apex in lateral aspect (Fig. 104) ..... *nielsoni* (p.162)
- 8 Aedeagal shaft serrated caudoventrally, apical process directed anteriorly and dorsally at apical 0.2 length (Fig. 130) ..... *synavei* (p.163)
- Aedeagal shaft smooth ventrally, apical process variable but directed antero-dorsally ..... 9
- 9 Aedeagal shaft cylindrical (Figs 117, 118) ..... 10
- Aedeagal shaft strongly laterally compressed (Figs 154, 162, 171) ..... 13
- 10 Aedeagal shaft with short, oppressed apical processes (Fig. 138) ..... *elongata* (p.164)
- Aedeagal shaft with longer apical processes not oppressed (Figs 117, 122, 147) ..... 11
- 11 Aedeagal shaft short, bulbous at base, narrowed distally, processes subapical, directed caudodorsally (Figs 146, 147) ..... *girijae* (p.164)
- Aedeagal shaft elongate, of uniform width, apical processes directed anterodorsally ..... 12
- 12 Head with two black round spots; dorsal margin of aedeagal shaft smooth in basal 0.25 (Fig. 117) ..... *pruthii* (p.163)
- Head with brown transverse stripes; dorsal margin of aedeagal shaft with denticles in basal 0.25 (Fig. 122) ... *confusa* (p.163)
- 13 Aedeagal shaft slightly broadened apically, with an arcuate excavation near gonopore on dorsal margin, apical process sculptured (Figs 171, 172) ..... *kumari* (p.165)
- Aedeagal shaft slightly narrowed apically, without an excavation on dorsal margin ..... 14
- 14 Basal part of aedeagus strongly expanded (Fig. 154); apical process of shaft short, directed caudolaterally (Fig. 155) ..... *wellingtoni* (p.164)
- Basal part of aedeagus less strongly expanded (Fig. 162); apical processes of shaft long, convergent, meeting each other at their apices (Fig. 163) ..... *compressa* (p.165)

*Carvaka picturata* Distant

(Figs 44–49)

*Carvaka picturata* Distant, 1918: 40; Zhang & Webb, 1996, Fig. 507. LECTOTYPE ♀, INDIA (BMNH), here designated [examined].



**DESCRIPTION.** Female 7.1 to 7.3 mm long, 2.13 to 2.15 mm wide across eyes. Coloration as described by Distant (1918) with following additions. Vertex with inner margins of eyes, a mesal spot nearer to them, a spot on either side of impressed line, a spot on apex of vertex, pale brown; coronal sulcus black with a basal dark brown spot; disc of pronotum with a pair of ill-defined brown patches and two dark castaneous spots anterior to them; lateral margin of scutellum black; basal two-thirds of prothoracic and mesothoracic femora brown; forewings hyaline with dark brown patches, veins dark brown. Dark margins of head not well developed in paler specimen (Fig. 45). Inner subapical cell closed behind, outer subapical cell smallest. Two m-cu cross veins present, a series of 3–5 cross veins reach costal margin.

Female genitalia with seventh sternum nearly 3× as wide as median length, hind margin medially slightly produced and notched. Second pair of valvulae with dorsal margin serrated even on surface of major teeth.

**MATERIAL EXAMINED** (2 specimens)

Lectotype ♀ **India:** 'L. 4–15, 78<sub>6</sub> Var.' 'Lovedale, Nilgiri Hills, S. India, 7200 ft, T.V. Campbell' 'S. India, E.A. Butler, 1915–60' 'C14' (BMNH).

Paralectotype ♀ (paler specimen), data as lectotype but with label 'L.6.15'.

**REMARKS.** This species is known only from the type series which represents the 'typical' form and the variety described by Distant (1918). Judging from the female seventh sternum these two 'forms' are conspecific. It is closely related to *thoracica* from which it differs in the shape of the female seventh sternum.

### *Carvaka thoracica* Distant

(Figs 50–59)

*Carvaka thoracica* Distant, 1918: 41; Zhang & Webb, 1996, Fig. 508. LECTOTYPE ♀, INDIA (BMNH), here designated [examined].

**DESCRIPTION.** Male 7.00 mm long, 2.00 mm wide across eyes. Female 7.40–7.60 mm long, 2.10–2.25 mm wide across eyes. Coloration as described by Distant (1918) with paler fore wings compared with those of *picturatus*. Inner subapical cell closed by a cross vein. Two m-cu cross veins present; two closely placed cross veins at the base of outer apical cell.

Male pygofer with small antero-lateral apodeme. Subgenital plate twice as long as wide at base. Style comparatively slender, elongate, with well developed subapical lobe, apophysis of style shorter, plate-like, with mesal half including apex sculptured, lateral angle produced, beak-like. Connective with stem 1.5×

as long as arms, caudally bifid with a dorsomedial membranous projection. A large stout appendage situated between shaft and aedeagus, directed ventrally and caudally, more than twice length of aedeagus, preatrium of aedeagus well developed, longer than shaft, dorsal apodeme broad, well developed; shaft small, slightly curved with subapical spatulate, anteriorly directed process on dorsal margin apically, gonopore apical.

Female seventh sternum twice as wide as median length, broadly produced medially and bilobed, posterior half chocolate brown. Second valvulae with surface of teeth serrated.

**MATERIAL EXAMINED** (7 specimens)

Lectotype ♀, **India:** 'Type H.T.' '*C. thoracica* Dist., type' 'Lovedale, Nilgiri Hills, S. India, 7, 200 ft., T.V. Campbell' '78' (BMNH). Two syntype ♀ were earlier mounted on the same card with 'L. 6.15, 786 Var.' written on reverse of the label along with the lectotype ♀. The lectotype is now mounted separately and labelled in the author's hand (BMNH).

Paralectotype 1 ♀, data as lectotype.

Other material examined. **India:** 2♂, 3♀, Tamil Nadu, Nilgiri Hills, Lovedale, (*Campbell*) (BMNH).

**REMARKS.** *C. thoracica* is closely related to and resembles *C. picturata*. Both the species possess two m-cu cross veins and two short veins on the costal margin connecting the outer apical cell. Both are sympatric and so far been collected only from the Nilgiri Hills. *C. thoracica* differs from *picturata* in the coloration of the vertex and in having a longer median process to the female seventh sternum.

### *Carvaka ochrophora* Distant

(Figs 60–71)

*C. ochrophora* Distant, 1918: 41; Zhang & Webb, 1996, Fig. 506. LECTOTYPE ♀, INDIA (BMNH), here designated [examined].

**DESCRIPTION.** Male 5.50 (5.40–5.60) mm long, 1.75 (1.70–1.80) mm wide across eyes. Female 6.00 (6.00–6.10) mm long, 1.97 (1.90–2.00) mm wide across eyes. Reddish ochraceous. Vertex with an apical and two lateral spots dark brown, a medially interrupted transverse band connecting posterior pair of spots pale brown. Pronotum with a few dark brown spots. Basal triangles of scutellum darker. Dorsal marginal stripe to face black, a series of transverse lateral spots on frontoclypeus and marginal area of clypellus and lorum in a few specimens dark brown. Fore wing unmarked or in darker specimens apices of claval veins and apex of clavus brown.

Male pygofer with a small apodeme on lateral anterior margin. Subgenital plate as long as wide at base. Apophysis of style broad, caudally truncate, outer



angle acutely pointed. Connective with arms half as long as stem. Aedeagus with well developed dorsal apodeme; shaft broadest at midlength, narrower both basally and more so apically, with a pair of anterodorsally directed apical processes; interconnecting sclerite produced into a stout caudally narrowed process slightly more than half as long as aedeagus.

Female seventh sternum twice as wide as broad, medially rather narrowly produced. Second pair of valvule with larger teeth interspersed with serrated area.

#### MATERIAL EXAMINED (34 specimens)

Lectotype ♀, **India**: 'K.K. 4-16' 'Type H.T.' '*Carvaka ochrophora* Dist. type' 'Kodaikanal, S. India, T.V. Campbell' '62' (BMNH).

Paralectotypes: 13♂, 5♀, data as lectotype.

Other material examined. **India**, Tamil Nadu: 2♂, 2♀, Kodaikanal, 2122 m, 24.iii.1936 (*BM-CM expedition to South India*) (BMNH), 6♂, 5♀, Kodaikanal, 9.vi.1980 (*Kumar*) (UAS).

**REMARKS.** *C. ochrophora* is related to *modesta* Distant from which it can be differentiated by the shape of the aedeagus and the stouter process of the interconnecting sclerite.

### *Carvaka modesta* Distant

(Figs 72-79)

*Carvaka modesta* Distant, 1918: 41; Zhang & Webb, 1996, Figs 31, 509. **LECTOTYPE** ♀, **INDIA**, (BMNH), here designated [examined].

*Selenocephalus brunneus* Pruthi, 1930: 37. Holotype ♀, **INDIA** (ZSI) [examined]. **Syn. n.**

**DESCRIPTION.** Male 6.20 (6.10-6.40) mm long, 1.80 (1.75-1.82) mm wide across eyes. Female 7.05 (6.80-7.50) mm long, 2.10 (1.98-2.28) mm wide across eyes. Coloration as described by Distant (1918).

Male pygofer without antero-lateral apodeme. Subgenital plate slender, elongate, more than twice as long as wide at base. Style elongate, apophysis broad, short, with truncate apex, outer apical angle acutely produced. Connective with arms as long as shaft. Process of interconnecting sclerite slender, slightly more than half as long as shaft. Dorsal apodeme of aedeagus well developed, aedeagal shaft directed caudally, slightly curved caudodorsally in apical half, with a pair of long anteriorly directed processes about half as long as shaft.

Female genitalia as in *ochrophora* but median lobe of seventh sternum more slender.

#### MATERIAL EXAMINED (24 specimens)

Lectotype ♀, **India**: 'Type, H.T.' '*Carvaka modesta* Dist., type' 'Nilgiri Hills, S. India, T.V. Campbell'

'79,' (BMNH).

Paralectotypes: 4♂, 4♀, carded specimens 'Kodaikanal, S. India, T.V. Campbell' (BMNH). Holotype ♀ (*brunneus*), '723/H7' 'Kodaikanal, Palney Hills, 15.v.1914, Muliylil Coll.' (ZSI).

Other material examined. **India**, Tamil Nadu: 1♂, 1♀, Shambaganur, 1820 m, 30.iii.1936 (*BM-CM Expedition to S. India*) (BMNH); 5♂, 7♀, Kodaikanal, 2133 m, 7-9.vi.1980 (*Kumar*) (UAS).

**REMARKS.** This appears to be a common species in Kodaikanal. It can be readily distinguished from other species of *Carvaka* by its elongated aedeagal shaft and the slender process of the interconnecting sclerite. The holotype of its junior synonym *S. brunneus* has a completely damaged abdomen and partially mutilated wings.

### *Carvaka sinuata* sp. n.

(Figs 80-87)

**DESCRIPTION.** Male 5.90 (5.70-6.00) mm long, 1.80 (1.77-1.84) mm wide across eyes. Uniformly pale brown with upper and lower marginal transverse dark brown band; a submarginal transverse band on vertex medially anteriorly produced and laterally more prominent. Apices of the claval veins and clavus with dark brown spots, venation in places dark brown. Head medially longer than next to eyes, 2.8× as wide between eyes as median length. Pronotum shorter than scutellum.

Male pygofer without apodeme. Valve with convex caudal margin. Subgenital plates more than twice as long as width at base. Style short, with well developed subapical lobe, apophysis broad, short, apically avicephaliform, caudal margin concave; surface transversely rugulose. Connective with stem about twice as long as arms, caudal margin of stem bilobed. Intermediate sclerite lacking. Aedeagus with a short dorsal apodeme, preatrium short, with a triangular caudoventrally directed process; shaft slender, tubular, narrowed caudally, strongly curved caudodorsally in apical three-quarters with a protuberance at basal one-quarter on dorsal margin, a pair of short apical processes directed anterodorsally.

#### MATERIAL EXAMINED (6 specimens)

Holotype♂, **India**: Tamil Nadu, Valparai, 1982 m, 13.iv.1981 (*Kumar*) (UAS).

Paratypes. **India**: 2♂, Kerala, Munnar, 22.iii.1975 (*Viraktamath*); 1♂, Thekkadi, 27.iii.1977, *Mallik*; 2♂, Karnataka, Kemmangundi, 10.iv.1975 (*Viraktamath*) (BMNH, UAS, NMNH).

**REMARKS.** *C. sinuata* can be easily recognised by its sinuate aedeagus which is tubular and elongate. It is related to *clava* from which it differs in having more slender processes to the apex of the aedeagal shaft.



*Carvaka clava* sp. n.

(Figs 88–99)

**DESCRIPTION.** Male 5.70 and 6.80 mm long, 1.77 and 2.00 mm wide across eyes. Female 6.70 (6.60–6.90) mm long, 2.00–2.05 mm wide across eyes. Brown. Anterior rim of head margined both dorsally and ventrally by dark brown band. A spot adjacent to anterior inner angle of eye dark brown. Apices of claval veins, apex of clavus dark brown; venation dark brown. Female with a medially interrupted submarginal transverse band dark brown; few spots on disc of pronotum dark brown. Head wider than pronotum, 2.3 to 2.8× as wide between eyes as median length. Scutellum slightly longer than pronotum.

Male pygofer without apodeme. Valve with convex caudal margin. Subgenital plates more than twice as long as width at base. Apophysis of style parallel sided, with rather truncate caudal margin, lateral angle produced laterally. Connective with stem 1.4× as long as arms. Dorsal apodeme of aedeagus slender. Preatrium well developed with caudoventrally directed process more than half as long as shaft, triangular in caudoventral view; shaft caudally directed in basal half, then dorsally bent, with a pair of short, knob-like processes on dorsal margin apically; gonopore apical.

Female seventh sternum twice as wide as median length; caudal margin convex with a median bilobed projection. Second valvulae with serrated teeth interspersed with serrated area.

**MATERIAL EXAMINED** (11 specimens)

Holotype ♂, **India:** Karnataka, Kemmangundi, 9.iv.1975 (*Viraktamath*) (UAS).

Paratypes. **India:** 2♂, data as holotype; 8♀, data as holotype but collected on 10 (5♀) and 11.iv.1975 (BMNH, NPC, UAS, NMNH).

**REMARKS.** *C. clava* is related to *sinuata* and differs from it in having a less convexly expanded ventral margin of the male pygofer, and having knob-like aedeagal shaft processes.

*Carvaka nielsoni* sp. n.

(Figs 100–108)

**DESCRIPTION.** Male 5.9 (5.8–6.0) mm long, 1.8 (1.72–1.8) mm wide across eyes. Female 6.5 mm long, 1.97 mm wide across eyes. Pale brown. Head with marginal and submarginal medially interrupted dark brown bands. In a few specimens (including holotype), submarginal band represented by a lateral spot near each eye. Fore wing with a brown spot at apices of each claval vein and clavus. Head wider than pronotum. Vertex 2.7 to 2.8× as wide between eyes as long. Pronotum shorter than scutellum.

Male pygofer with rounded caudal lobe, dorsal margin with a basal black pigmented area. Subgenital plate twice as long as basal width. Style with stout apophysis, lateral angle produced into a beak-like structure, mesal angle rounded. Connective with stem twice as long as arm. Dorsal apodeme of aedeagus well developed, aedeagus with a short preatrium bearing a rather heart shaped process directed ventro-caudally, shaft directed caudally in basal three-quarters, then curved dorsad, slender, with a pair of short, apical processes; gonopore apical.

Female seventh sternum 2.4× as wide as median length, hind margin straight with a median short bilobed process.

**MATERIAL EXAMINED** (11 specimens)

Holotype ♂, **India:** Karnataka, Kemmangundi, 1430 m, 8.iv.1975, *Ghorpade* (UAS).

Paratypes. **India:** Karnataka: 1♂, data as holotype but 11.iv.1975 (*Viraktamath*); 1♂, 1♀, Kottigehara, 27.i.1978 (*Viraktamath*); Tamil Nadu, 1♂, Lovedale, 2366 m, 15.iv.1906, (*Campbell*), 2♂, 4 ex., Coonoor, (*Campbell*) (BMNH, NPC, UAS, NMNH).

**REMARKS.** *C. nielsoni* is distantly related to both *clava* and *sinuata*. It has a much stouter dorsal apodeme, a rounded apical pygofer lobe and shorter apical processes to the aedeagal shaft.

*Carvaka dolens* (Melichar)

(Figs 109–110)

*Selenocephalus dolens* Melichar, 1903: 170.

Lectotype ♀, **SRI LANKA** (MNHU), designated by Zhang & Webb, 1996: 13 [examined].

*Carvaka dolens*: Zhang and Webb, 1996: 13.

**DESCRIPTION.** Female 7.20 mm long, 2.07 mm wide across eyes. Pale brownish. A transverse stripe on anterior margin of vertex brown becoming darker laterally, an irregular stripe posterior to it interrupted in middle, brown. A dorsal marginal stripe on face and second antennal segment brown. A series of spots on anterior part of pronotum brown. A dorsal marginal stripe on face and second antennal segment brown. A series of spots on anterior part on pronotum brown. Basal triangles of scutellum brown. Forewing veins brown. Two spots on either side of median line of hind margin of seventh sternum brown.

Female seventh sternum nearly twice as wide as median length, hind margin very slightly sinuate.

**MATERIAL EXAMINED** (1 specimen)

Lectotype ♀, **Sri Lanka:** 'Type' '7044' 'Ceylon Nectn' 'dolens M. det. Melichar' '*Selenocephalus dolens* Melichar' (MNHU).

**REMARKS.** The species is known only from a single



female. It resembles *modesta* but the female seventh sternum is not as strongly produced medially.

***Carvaka pruthii* sp. n.**

(Figs 111–119)

[*Divus bipunctatus*; Pruthi, 1934a, misidentification.]

**DESCRIPTION.** Male 5.40 and 5.60 mm long, 1.75 and 1.80 mm wide across eyes. Brownish yellow. One round spot on either side of median line on vertex, antennal pits black. Median stripe on disc of pronotum mottled with brown. Scutellum beyond median impressed line bright yellow. Fore wing venation brownish, prominent. Vertex longer medially than next to eyes, 2.6× as wide between eyes as long medially, anterior marginal rim with six transverse rugae. Pronotum shorter than scutellum.

Male pygofer with anterior margin without apodemes. Subgenital plate more than twice as long as width at base. Apophysis of style parallel sided, apically aviccephaliform with mesally pustulated area. Connective with arms as long as stem, caudally bilobed. Aedeagus with well developed dorsal apodeme, half as long as shaft, strongly bilobed, shaft slender, elongate, dorso-caudally curved at base then straight, with a pair of anteriorly directed processes, each process with an angular projection in distal half.

**MATERIAL EXAMINED** (4 specimens)

Holotype♂, **India:** Karnataka: Kemmangundi, 9.iv.1975 (*Viraktamath*) (UAS).

Paratypes. **India:** 2♂, Mysore, Chikballapur, viii. 1916; 1♂, data as holotype (BMNH).

**REMARKS.** *C. pruthii* externally resembles *Divus bipunctatus* Melichar and was misidentified by Pruthi (1934a) as that species. It is closely related to *confusa* from which it differs in coloration and the structure of the aedeagus (see discussion under that species).

***Carvaka confusa* sp. n.**

(Figs 120–123)

**DESCRIPTION.** Male 6.0 mm long, 1.75 mm wide across eyes. Coloration and structure similar to *C. modesta* but venation more prominent and dark brown, apex of clavus and claval veins brown.

Male genitalia similar to *pruthii* but connective stem broader, widening slightly caudally with a U-shaped caudal excavation. Aedeagal shaft more broadly curved at base, dorsal apodeme longer (about 0.4 as long as shaft), shaft with two prominent denticles on dorsal surface in basal quarter, and another at basal one-third, processes of shaft slender and shorter than in *pruthii*.

**MATERIAL EXAMINED** (1 specimen)

Holotype♂, **India:** Kerala, 12 Km N. Munnar, 2000 m, 23.iii.1977 (*Viraktamath*) (UAS).

**REMARKS.** Although externally *confusa* resembles *modesta* it is closely related to *pruthii* which lacks the two black spots on the vertex; it differs from *pruthii* in having i) shorter aedeagal processes ii) denticulate dorsal margin of base of aedeagal shaft and iii) less divergent lobes of dorsal apodeme of aedeagus.

***Carvaka synavei* sp. n.**

(Figs 124–131)

**DESCRIPTION.** Male 6.70 (6.60–6.80) mm long, 2.02 (2.00–2.05) mm wide across eyes. Female 7.5 mm long, 2.22 mm wide across eyes. Brown. Vertex with a broad dark brown patch enclosing a median, oval, yellow spot and with lateral and posterior median notches (Fig. 124). Face light brown; frontoclypeus with lateral brown spots, suture and bases of antennae dark brown. A lateral spot near each eye on posterior margin dark brown. Pronotum with dark brown maculae often surrounding round pale areas, a median anterior and two lateral transverse stripes yellowish white; a lateral most area of pronotum whitish. Scutellum with most lateral areas and posterior half, except for a short median brown stripe, yellow. Fore wing brown with dark brown veins, a spot at base white, apices of claval veins, apex of clavus, cross veins dark brown. A sub-basal and a sub-apical spot on fore femora, outer surface of fore tibia and bases of hind tibial spines dark brown. Female darker than male with facial markings more pronounced. Vertex slightly longer medially than next to eye, 2.7 to 3.0× as wide between eyes as median length. Pronotum as long as scutellum.

Male pygofer as in *ochrophora*. Style with rather parallel sided central body, apophysis laterally curved with pointed lateral apical angle and a subapical tooth on mesal margin, its surface transversely rugulose. Connective with stem as long as arms. Interconnecting sclerite well developed, without process. Aedeagus as in *ochrophora* but more robust, compressed, shaft directed caudally at basal half then caudo-dorsally, caudal margin serrate; a pair of ventrally directed subapical processes.

Female seventh sternum twice as broad as median length; caudal margin medially produced with a bilobed process with a notch on either side of this process.

**MATERIAL EXAMINED** (4 specimens)

Holotype♂, **India:** Cinchona, Anaimalai Hills (3500 ft (1062 m), iv/v. 1957 (*Nathan*) (RISNB).

Paratypes: **India:** 2♂, 1♀, data as holotype; 1♂ (teneral), Tamil Nadu, Kodaikanal, 9. vi. 1980 (*Kumar*), Coll. No. 180 (UAS, RISNB).



REMARKS. Externally *synavei* resembles *compressa* in coloration but the two bands on the vertex are fused to form a broad brown patch encircling a median whitish yellow spot. Although the dorsal areas are darker compared with *compressa*, the face is paler. This species is closely related to *ochrophora* but lacks a process on the interconnecting sclerite, has a stouter aedeagus with a shorter and stouter processes to the shaft and the apophysis of the style is differently shaped.

### *Carvaka elongata* sp. n.

(Figs 132–139)

DESCRIPTION. Male 5.90 (5.70–6.20) mm long, 1.80 (1.77–1.84) mm across eyes. Yellow, with a round spot on each side of median line on vertex, bases of antennae, a short transverse stripe on scutellum partially concealed by pronotum, black. Anterior ridge of head with eight transverse rugae; medially longer than next to eyes, three times as wide between eyes as long. Pronotum shorter than scutellum.

Male pygofer with anterior margin without apodeme. Subgenital plate more than 2.5× as long as wide at base. Style with apophysis slender, caudal margin truncate with lateral apical angle produced into a pointed process. Connective as in *C. kumari*. Interconnecting sclerite absent. Aedeagus elongate, dorsal apodeme short, less than one-quarter length of shaft, shaft caudodorsally curved, caudally narrowed with two closely oppressed caudodorsally directed processes.

MATERIAL EXAMINED (3 specimens)

Holotype ♂, **India:** Kerala, Maraiyur, 24.iii.1977 (S.A. Viraktamath) (UAS).

Paratypes: **India:** 1♂, data as holotype but collector C.A. Viraktamath; 1♂, Karnataka, Devaraya Durg, x.1917 (*Campbell*) (BMNH, NPC).

REMARKS. Externally *elongata* resembles *pruthii*, but can be differentiated by the transverse black basal spot on scutellum and caudally narrowed aedeagal shaft with short oppressed apical processes.

### *Carvaka girijae* sp. n.

(Figs 140–148)

DESCRIPTION. Male 5.80 (5.60–6.00) mm long, 1.82 (1.75–1.89) mm wide across eyes. Female 6.80 (6.50–7.00) mm long, 2.12 (2.00–2.20) mm wide across eyes. Yellow brown. Transverse spot on either side of median line on vertex black. Clypellus, lateral margin of frontoclypeus, antennal pit, dark brown. A transverse band on disc of pronotum mottled with dark brown. In darker specimens dark brown areas are more

extensive including lower rim of vertex which is reddish in paler specimens. Fore wing veins brown to dark brown, cross veins, apices of claval veins, clavus broadly dark brown. Anterior rim of head with four transverse rugae, medially longer than next to eyes, 2.7- to 3.0× as wide between eyes as long medially. Pronotum shorter than scutellum.

Male pygofer with anterior margin without apodeme. Subgenital plate 2.7× as long as broad at base. Style with apophysis short, slender, slightly curved laterally, caudal margin truncate with outer apical angle produced laterally. Connective with stem about 1.5× longer than arms. Interconnecting sclerite absent. Aedeagal shaft cylindrical with a ventral median ridge, expanded basally then narrowed caudally, caudodorsally directed, with a pair of elongate apically divergent subapical processes; dorsal apodeme short, broad, caudally rounded.

Female seventh sternum twice as wide as median length, hind margin broadly medially produced with a median notch. Second pair of valvulae with widely spaced, smooth-margined teeth, space between teeth serrated.

MATERIAL EXAMINED (22 specimens)

Holotype ♂, **India:** Karnataka, Kemmangundi, 10.iv.1975 (Viraktamath) (UAS).

Paratypes: **India:** Karnataka: 5 ♀, data as holotype but collected by C.A. Viraktamath on 9 (3 ♀) and 11.iv.1995 (1 ♀) and K.D. Ghorpade on 9.iv.1995; 1 ♀, Dharmasthala, 17.i.1994 (Viraktamath); 1♂, Nandi Hills (1467 m), 3, vii.1977 (Viraktamath); 1 ♀, Biligirirangana Hills, 1100 m, 11.viii.1977 (Viraktamath); 1 ♀, 20 Km NW Doddaballapur, 18.vi.1977 (Viraktamath); 3 ♀, Mudigere, 28.i.1983 (Shashidhar). Tamil Nadu: 1♂, 2 ♀, Coonoor, 11.viii.1979 (Viraktamath); 3♂, 2 ♀, Yercaud, 19–20.ix.1978 (Viraktamath); 1 ♀, Yercaud (4500 ft), 11.iii.1955 (Nathan) (IRSNB, BMNH, NPC, UAS, NMNH).

REMARKS. This species has so far been collected in areas above 1000 m. It can be easily distinguished by its darker face, a character it shares with *kumari* among the species of *Carvaka* having two black spots on the vertex. It can be easily distinguished from *kumari* in having a cylindrical rather than compressed aedeagal shaft.

### *Carvaka wellingtoni* sp. n.

(Figs 149–155)

DESCRIPTION. Male 6.20 (6.10–6.40) mm long, 1.90 (1.80–1.90) mm wide across eyes. Coloration and structure similar to *compressa* but the markings on head paler.

Male pygofer with anterior margin without apodeme, lobe caudally obtusely rounded. Subgenital

plate slightly more than twice as long as wide at base. Style with apophysis curved laterally, apex rather truncate, with laterally produced distally pointed apical angle. Connective with stem longer than arms, caudal margin straight with a median notch. Interconnecting sclerite present. Aedeagal shaft strongly compressed, broadly expanded at base, narrowed rather abruptly at one-third and of uniform width before apex where it is narrowed, with a pair of short subapical processes directed caudodorsally; dorsal apodeme one-third as long as shaft, broad.

#### MATERIAL EXAMINED (2 specimens)

Holotype♂, **India:** Tamil Nadu, Wellington (near Coonoor), 12.viii.1979 (*Dworakowska*) (UAS).

Paratypes: 1♂, **India:** Karnataka, Kimmangundi, 10.iv.1975 (*Viraktamath*) (BMNH).

REMARKS. This species is related to *compressa* but it differs in having shorter subapical processes to the shaft and the shaft being much narrower in its distal half.

#### *Carvaka compressa* sp. n.

(Figs 156–163)

DESCRIPTION. Male 6.00 mm long, 1.83 mm wide across eyes. Female 6.80 mm long, 2.05 mm wide across eyes. Head and thorax yellowish, a medially interrupted submarginal band and a short lateral transverse band on vertex, a dorsal transverse band on face, a series of sublateral dashes and a median stripe on frontoclypeus, apex of frontoclypeus, clypellus and antennal pits, dark brown. Lateral margins of pronotum dark brown. Inner claval margin upto apex of outer claval vein, apex of clavus and veins dark brown.

Female darker than male. Vertex with area anterior to transverse impressed line dark brown with a median semicircular notch, submarginal transverse band dark brown but broader on either side of median line. Face darker than in male, with lateral areas of frontoclypeus as well as lorum dark brown. Disc of pronotum with dark brown patches surrounding pale circular areas. Scutellum yellow with basal three areas and distal two spots brown. Head longer medially than next to eyes, three times as wide between eyes as median length. Pronotum shorter than scutellum.

Male pygofer with anterior margin without a prominent apodeme, lobe angularly rounded. Subgenital plate more than twice as long as wide at base. Apophysis of style curved laterally, its outer apical angle pointed, surface transversely rugulose. Connective with stem 1.5× as long as arms. Interconnecting sclerite lacking. Aedeagal shaft laterally compressed with ventrally expanded base, directed caudodorsally with a pair of caudodorsally directed processes which meet

each other mesally; with well developed dorsal apodeme.

Female seventh sternum less than twice as broad as long medially, hind margin triangularly produced.

#### MATERIAL EXAMINED (3 specimens)

Holotype♂, **India:** Tamil Nadu, Shambaganur, 8.vi.1980 (*Kumar*) Coll. No. 179 (UAS).

Paratypes: **India:** 1♂, data as holotype, 1♀, data as holotype but 18.viii.1979 (*Viraktamath*) (BMNH, UAS).

REMARKS. Both *compressa* and *wellingtoni* are very similar in coloration and in structure of male genitalia; however, the proportional length of the subapical processes to the aedeagal shaft is greater; the processes are convergent and the shaft stouter in the apical half in *compressa* while in *wellingtoni* the shaft is stouter in the basal half and the processes are shorter and divergent.

#### *Carvaka kumari* sp. n.

(Figs 164–172)

DESCRIPTION. Male 5.88 mm long, 1.8 mm wide across eyes. Yellowish brown. A large, rather triangular spot on either side of median line on vertex, black; median sulcus brown. Clypellus with lateral margin of frontoclypeus broken into short transverse stripes, area surrounding base of antennae dark brown. Disc of pronotum with mottled transverse stripe, dark brown. Scutellum yellow with a black spot on each lateral margin. Forewing venation prominent, dark brown, apices of claval veins, apex of clavus, cross veins broadly dark brown. Head with anterior rim with two or three rugae, medially longer than next to eyes, about 2.3× as wide between eyes as median length. Pronotum about as long as scutellum.

Male pygofer with anterior margin without apodeme, caudal lobe broadly rounded. Subgenital plate 2.3× as long as wide at base. Style with avicephaliform apex of apophysis, surface transversely rugose. Connective stem 1.5× as long as arms. Intermediate sclerite absent. Aedeagal shaft strongly compressed, blade-like, with a small apical gonopore, with an arcuate excavation dorsoapically and with a pair of slender antero-laterally directed, pustulated processes; dorsal apodeme short, broad, distally bilobed.

#### MATERIAL EXAMINED (1 specimen)

Holotype♂, **India:** Mysore State (Karnataka), Ag. Coll. Dharwar, 27.ii.1975 (*Viraktamath*) (UAS).

REMARKS. *C. kumari* can be easily recognised by the truncate apex and both dorsal and ventral C-shaped excavations of the shaft; a pair of pustulated processes arise from the ventral excavation. It is re-



lated to *compressa* and *wellingtoni* and externally resembles *girijae*.

## DIVUS Distant, 1908

*Divus* Distant, 1908: 365. Type species: *Eutettix bipunctatus* Melichar, by original designation.

**DESCRIPTION.** Yellow to yellowish brown with two prominent black spots on vertex or with a transverse black stripe, veins brownish. Head wider than pronotum, anterior margin fairly sharply defined with upper and lower prominent transverse carinae and area between them traversed by four to five transverse rugae. Vertex little longer medially than next to eyes, disc anteriorly transversely impressed, behind this a series of longitudinal striae which diverge laterally and become almost transverse near lateral extremities (Fig. 173). Ocelli situated on anterior margin, a distance greater than own diameter from adjacent eye. Eyes prominent, posterolateral margins overhanging anterolateral angles of pronotum. Antennae 0.66–0.75 length of body, antennal ledge prominent. Clypellus widened apically. Pronotum transversely rugulose, except on anterior margin (Fig. 173). Scutellum granulate in anterior half, transversely rugulose in posterior half. Forewing elongate (ratio of width at mid length to length 1:3.5–4.0), outer claval vein joined to claval suture by a cross vein, three subapical cells, inner subapical cell open behind. Hind femoral spinulation 2+2+1, hind tibial spinulation  $R_1$  21±2,  $R_2$  11±1,  $R_3$  20±2. Hind basitarsomere with three platellae.

Male pygofer with expanded ventral margin, anterior half without setae. Anal collar simple without appendages. Valve rather trapezoidal. Subgenital plate broad at base, apex drawn out, devoid of stout setae. Style broad at base, preapical lobe prominent, apophysis of style with transverse rugae or denticles, apex avicephaliform. Connective Y-shaped with long stem. Aedeagus articulated with connective, with ventral unpaired process longer than shaft, and with a pair of basal processes curved along with shaft, gonopore apical; basal apodeme well developed.

**REMARKS.** The species of *Divus* externally resemble some species of *Carvaka* such as *pruthii* and *modesta* as they have similar coloration. However, *Divus* differs in male genital characters especially in having an unpaired ventral process to the aedeagus and shaft with a pair of basal processes. The genus appears closely related to *Carvaka*.

## Key to species of *Divus*

- 1 Vertex of head with a large black spot on either side of

median line; style with caudal margin of apex of apophysis rather straight (Fig. 178) (Sri Lanka) .....

..... *bipunctatus* (p.166)

- Vertex of head with a transverse black band in addition to a lateral small black spot adjacent to eye; style with caudal margin of apex of apophysis rounded (Fig.187) (India: Nilgiri Hills) ..... *samanus* (p.166)

## *Divus bipunctatus* (Melichar)

(Figs 173–182)

*Eutettix bipunctatus* Melichar, 1903: 192. Holotype ♂, SRI LANKA (MNHU) [examined].

*Divus bipunctatus*: Distant, 1908: 365; Zhang & Webb, 1996, fig. 482.

**DESCRIPTION.** Male 5.60 mm long, 1.65 mm wide across eyes. Ochraceous. Two spots on anterior margin of vertex and one on each posterolateral corners of eye black. Small spot on disc of vertex near posterior margin brownish. Fore and hind wing venation brown.

Male pygofer conically produced caudally. Subgenital plate with apical membranous process, with microsetae on membranous area. Valve almost parallel sided, with a triangular process on anteromedian margin. Style robust, preapical lobe rounded, short, apophysis long with a lateral beak-like expansion. Aedeagal shaft strongly curved dorsally, unpigmented with an antero-median, short projection, unpaired ventral process with bilobed caudal tip, gonopore terminal; dorsal apodeme well developed.

**MATERIAL EXAMINED** (1 specimen)

Holotype ♂, **Sri Lanka**: 'Type' '6269' 'Ceylon, Nictner' 'Eutettix' 'bipunctatus m, det. Melichar' 'Eutettix bipunctatus Melichar' (MNHU).

**REMARKS.** *D. bipunctatus* resembles *Carvaka pruthii* and *kumari* in coloration but has entirely different male genitalia.

## *Divus samanus* sp. n.

(Figs 183–190)

**DESCRIPTION.** Male 4.80 mm long, head 1.77 mm wide across eyes. Uniformly pale brown, a transverse band above and below anterior margin of head, a submarginal transverse band on lateral margin of vertex near eye, lateral angles of pronotum and clypellus dark brown.

Male pygofer caudally rather truncate with long setae on caudodorsal area. Style with inner basal arm mesally elongated, apophysis with a short mesal tooth and a lateral prolongation, apex rounded. Aedeagus with ventral appendage tapered caudally and caudo-



dorsally curved, exceeded in length by similarly curved lateral basal processes, apex with a pair of flange-like processes.

MATERIAL EXAMINED (1 specimen)

Holotype ♂, **India:** Nilgiri Hills, Coonoor (*Campbell*), 62, S. India, E.A. Butler, 1915–60 (BMNH).

REMARKS. *D. saman* resembles many species of *Carvaka*, but has the distinctive male genitalia of *Divus*. It differs from *D. bipunctatus* in coloration, shape of the male pygofer, aedeagus and the style.

**KUTARA Distant, 1908**

*Kutara* Distant, 1908:308; Zhang & Webb, 1966: 16.

Type species: *Kutara brunnescens* Distant, by original designation.

DESCRIPTION. Ochraceous to brown, head marked with black spot or transverse line. Antennal pedicel dark brown. Forewing veins prominently dark brown, cells medially with brown stripes. Pronotum brown with roundish paler spots. Robust species. Head wider than pronotum, short; anterior margin rimmed with upper and lower ridges, transversely striated between. Vertex declivous, disc longitudinally striate, with subapical deep transverse impression, 4.5 to 7.0× as wide between as long medially. Face rather flat, broad, transversely rugulose dorsad of antennal bases; ocelli placed on rim twice own diameter from adjacent eye; clypellus rather narrowed in middle; lorum broader than clypellus. Anterior arm of tentorium L-shaped, without protuberance at junction of L (Fig. 215). Pronotum more than twice as wide as median length, transversely striated, with scattered punctures. Scutellum longer than pronotum, posterior half transversely striated. Forewing with claval veins joined by a cross vein, a cross vein between outer claval vein and claval commissure, four apical and three subapical cells, inner subapical cell open behind. Fore tibia with flat dorsal surface. Hind femoral spinulation 2+2+1. Hind tibial spinulation  $R_1$  27 ± 2,  $R_2$  12 ± 1,  $R_3$  15 ± 2. Hind basitarsomere with three, rarely four platellae.

Male pygofer with a group of long setae caudodorsally in caudal half, without a process. Valve strap-like. Subgenital plate devoid of long setae, with or without a narrow caudal extension. Anal tube broad at base. Style broad at base, preapical lobe poorly to well developed, apophysis with a subapical tooth when well developed making the apophysis bifid or without tooth. Connective Y-shaped, stem usually longer than arms, rarely bifid, slightly angled at midlength in lateral aspect. Aedeagus with well developed dorsal apodeme, shaft slender, elongate, curved dorsally, distally with a median prolongation which is tapering and often associated with lateral prolongations; gonopore preapical.

Female seventh sternum variable, posterolateral angles moderately to greatly prolonged, eighth sternum often visible. Second valvulae with proximal tooth-like prominence and smaller teeth interspersed between prominent teeth (Fig. 204).

REMARKS. *Kutara* is related to *Carvaka* among the Indian genera studied. It differs from *Carvaka* in having a much shorter head and an uncompressed aedeagal shaft. It also lacks the interconnecting sclerite found in some species of *Carvaka* and has a cross vein between the claval veins. Zhang and Webb (1996) considered this genus similar to *Drabescoides* Kwon and Lee from which it differs in having the stem of the connective narrow rather than broad.

**Key to species of *Kutara* from the Indian sub-continent**

- 1 Males ..... 2
- Females (except *crypta* which is known only from males) ..... 7
- 2 Subgenital plates short, broader than long (Fig. 239); caudal margin of pygofer serrated (Fig. 238); aedeagus with lateral pair of processes divergent at two-thirds length of shaft (Fig. 243) (India: Mizoram) ..... *brevipata* (p.170)
- Subgenital plates longer than broad (Figs 196, 206); aedeagal shaft without lateral processes at midlength except apically, shaft may be keeled either dorsally or ventrally or with processes (Figs 200, 210, 221) ..... 3
- 3 Aedeagal shaft with ventral or dorsal keel, apex with three processes (Figs 200, 210) ..... 4
- Aedeagal shaft without keel, apex with a single ventral process (Figs 221, 230, 232), may have denticles laterally ..... 5
- 4 Aedeagal shaft with a ventral keel, produced into a dentate process ventrally (Fig. 200); apophysis of style robust, appearing bilobed (Fig. 197); connective not deeply bilobed caudally (Fig. 199) (south India, Sri Lanka) ..... *brunnescens* (p. 168)
- Aedeagal shaft with a dorsal keel (Fig. 210); apophysis of style slender with a subapical tooth (Fig. 207); connective deeply bilobed caudally (Fig. 209) (India: Darjeeling) ..... *trifida* (p. 168)
- 5 Subgenital plate caudally upturned (Figs 225, 232); aedeagal shaft without subapical lateral tooth ..... 6
- Subgenital plate caudally not upturned; aedeagal shaft with subapical lateral tooth (Figs 221, 222) (south India) ..... *striata* (p. 169)
- 6 Apophysis of style plate-like (Fig. 228); pygofer lobe caudally conically rounded (Fig. 225) (Burma) ..... *crypta* (p.170)
- Apophysis of style digitate (Fig. 234); pygofer lobe caudally rounded (Fig. 232) (Sri Lanka) ..... *transversa* (p.170)



- 7 Vertex longer medially than next to eyes; seventh sternum with sinuate hind margin with lateral rounded lobes (Fig. 223) (south India) ..... *striata* (p. 169)
- Vertex shorter medially than next to eyes; seventh sternum with posterolateral angles prolonged ..... 8
- 8 Seventh sternum visible only as two lateral lobes with ribbon like posterolateral prolongations (Fig. 244) (India: Mizoram) ..... *breviplata* (p. 170)
- Seventh sternum not divided as above ..... 9
- 9 Seventh sternum medially broadly produced with V-shaped excavation (Fig. 213) (India: Darjeeling) ..... *trifida* (p. 168)
- Seventh sternum medially entire, rather straight ..... 10
- 10 Seventh sternum with posterolateral corners acutely produced (Sri Lanka) ..... *transversa* (p. 170)
- Seventh sternum with posterolateral corners bluntly angled (Fig. 203) (south India; Sri Lanka) ..... *brunnescens* (p. 168)

### *Kutara brunnescens* Distant

(Figs 191–204)

*Kutara brunnescens* Distant, 1908: 308–309; Zhang & Webb, 1966: 16, figs 29, 168–174, 498 (habitus).  
Lectotype ♂, SRI LANKA (BMNH), designated by Zhang & Webb, 1966 [examined].

**DESCRIPTION.** Male 6.50 mm long, 2.32 mm wide across eyes. Female 7.60 mm long, 2.80 mm wide across eyes. Ochraceous. Vertex with a median transverse black spot sometimes extended laterally by a thin line. In a few specimens an oblique dash on either side of transverse spot dark fuscous. In darker specimens lateral aspect of frontoclypeus and clypellus brown. Anterior third of pronotum ochraceous, posterior two-thirds brown mottled with ochraceous round spots. Scutellum ochraceous with longitudinal brown lines, two short lines bordering basal triangles, a median and two lateral longer stripes. Venation of forewing dark brown, cells marked medially with faint brown stripe. Vertex 5.3 to 7.0× as wide between eyes as its median length, with lateral arcuate impressions on either side. Pronotum transversely striate in posterior two-thirds, punctured, shorter than scutellum, 2.2× as wide as median length.

Male genital capsule depressed. Pygofer lobe caudally truncate. Subgenital plate broad basally, narrowed distally, produced into a short apical membranous process, about 1.25× as long as wide. Basal half of style stout; apophysis stout, with a subapical short thumb-like process mesally, thus appearing bifid, transversely rugose, lateral part broader. Connective with arms touching each other, stem twice as long as arms. Aedeagus with well developed

crescent-shaped dorsal apodeme; shaft uniformly caudodorsally curved, tapering distally, apex trifid with a median process strongly acuminate distally compared with lateral processes, a strong keel developed along mid ventral margin produced distally at about mid length of shaft with slender elongate process with basal tooth or teeth; gonopore on dorsal surface at about mid length of shaft.

Female seventh sternum four times as wide as median length medially concave, lateral angle slightly produced posteriorly. Eighth sternum visible.

#### MATERIAL EXAMINED (6 specimens)

Lectotype ♂, **Sri Lanka**: Peradeniya, iii.1908, Distant Coll., 1911–383 (BMNH).

Paralectotype ♀, **Sri Lanka**: Uva P. 16.xi.1908 (Fletcher) (BMNH).

Other material: **India**: Karnataka, 1 ♂, 1 ♀, 8–12 km. N. Karwar, 18.xii.1983 (*Viraktamath*); 1 ♀, 9 km, W. Kollegal, 8.viii.1977 (*Viraktamath*) (UAS). **Nepal**: 1 ♂, Mugling, 900–1500', 14.i.–5.ii.1982, (*Jessop*) (BMNH).

**REMARKS.** *K. brunnescens* can be readily recognised by the bifid style apices, the ventral keel of the aedeagal shaft terminating in a dentate process and by the crescent-shaped dorsal apodeme. Externally it very closely resembles *transversa* Zhang and Webb from Sri Lanka but differs in having a bifid rather than digitate style apophysis. The female seventh sternum in *brunnescens* is less acutely produced posterolaterally than in *transversa*.

### *Kutara trifida* sp. n.

(Figs 205–213)

**DESCRIPTION.** Male 7.6 mm long, 2.1 mm wide across eyes. Female 8.4 mm long, 2.9 mm wide across eyes. Pale brown. A transverse spot on vertex with its anterior margin laterally extended by linear streak, black. Frontoclypeus with a series of transverse brown spots laterally. Pronotum with a few brown spots. Scutellum with a pair of lateral longitudinal short lines and a longer arcuate longitudinal stripe on either side of median line brown. Forewing light brownish hyaline, with prominent dark brown veins, cells medially marked with brown stripes, apical margin bordered with brown. Female with legs and lateral area of face reddish pale brown. Head 7.0× as wide between eyes as median length. Pronotum 2.3× as wide as long.

Male pygofer rather elongate, lobe narrow caudally, long, stout, setae confined to dorsocaudal area, dorsoventral area with fine setae, series of short stout setae along ventrocaudal and dorsocaudal margin. Subgenital plate broad basally, drawn out caudally into an attenuated process, 2.7× as long as wide at base. Style with

short, stout, laterally curved, apically bluntly rounded apophysis, with a subapical tooth, surface rugulose. Connective rather X-shaped, proximal arms twice as long as distal arms. Aedeagus with slender plate-like dorsal apodeme; shaft with a dorsal keel, apex terminated by three processes, two lateral and a median, the latter more strongly dorsoanteriorly curved, gonopore subapical on dorsal side.

Female seventh sternum twice as long as median length, lateral angles lobe-like, caudally produced, median area broadly produced caudally with a deep median notch. Sterna of the eighth segment visible as short lateral lobes.

#### MATERIAL EXAMINED (2 specimens)

Holotype♂, (upper dissected specimen on the pin) and paratype♀, (lower undissected specimen) collected *in copula* and mounted on the same pin, **India**: W. Bengal, Gopaldhara, Darjeeling, 3440–4720 ft (1043–1432 m), 7.ix.1917 (*Stevens*) (BMNH).

REMARKS. *K. trifida* resembles and is related to *brunnescens* and *transversa*. It can be distinguished from these by the style with a simple apophysis, the aedeagus with shaft without a ventral keel and with a plate-like dorsal apodeme, X-shaped connective and acute angled pygofer lobe.

#### *Kutara striata* sp. n.

(Figs 214–224)

DESCRIPTION. Male 6.50 (6.30–6.90) mm long, 2.12 (2.05–2.22) mm wide across eyes. Female 7.60 (7.10–7.80) mm long, 2.50 (2.30–2.60) mm wide across eyes. Pale brown to dark brown. Anterior rim of head more prominently between ocelli and a transverse fascia along anterior impressed line of vertex joining anterior rim with irregular margins black. Vertex, upper part of face lemon yellow to ochraceous. Frontoclypeus and clypellus in darker specimens brown, in paler specimens only clypellus brown, frontoclypeus may have a median and lateral margins brown, lateral area of genae brown, rest of face ochraceous. Eyes black with a transverse pale fascia in line with anterior rim of head yellowish to ochraceous. Antennal pit fuscous. Pronotum with yellow to ochraceous anterior margin, rest chocolate brown with numerous scattered circular ochraceous spots. Scutellum with basal triangles brown, median and posterior half with dark brown and irregular ochraceous spots. Forewings brownish hyaline, veins chocolate brown, each cell with a median dark brown fascia, apex of clavus, apical margin of forewing dark brown. Fore coxae, longitudinal fascia on fore femora fuscous in pale specimens. Middle and hind legs pale brown to dark brown. Sterna pale brown to dark brown. Head rather broadly triangular, vertex slightly

longer medially than next to eyes (1.1 to 1.2× as long medially as next to eye), longitudinally striate only anteriorly, posterior margin shagreened. Face shagreen, pronotum obscurely transversely striate, polished.

Male pygofer with caudal lobe obtusely rounded, a few long hair like setae ventrally. Valve broadly triangular. Subgenital plate triangular, caudally gradually narrowed without stout setae, twice as long as broad at base. Style with well developed subapical lobe, apophysis curved laterally. Connective with stem 1.5× as long as arms, caudally widened. Aedeagus with well developed but short (one-third length of shaft) dorsal apodeme; shaft gently curved caudodorsally with a long apical process arising from ventral margin, a pair of lateral denticles one on either side subapically, gonopore small.

Female seventh sternum twice as wide as long, hind margin sinuate, with lateral rounded lobes, medially notched.

#### MATERIAL EXAMINED (44 specimens)

Holotype♂, **India**: Karnataka, Yellapur, 15.xi.1977 (*Viraktamath*) (UAS).

Paratypes: **India**: Karnataka: 3♂, Yellapur, 23.ix.1973 (*Viraktamath*) (1♂), 15.xii.1983 (*Viraktamath*) (2♂); 6♂, 6♀, Mudigere, 970 m, 7.iv.1975 (2♀ (*Viraktamath*)), 23.v.1975, (2♂ (*Viraktamath*)), 22.v.1976 (1♂, 1♀ (*Viraktamath*)); 1♂, (*Mallik*), 1♂, 1♀, 2.vi.1978 (1♀ (*Krishnamurthy*)), 1♂ (*Viraktamath*)), 6.iv.1980 (1♂, 2♀ (*Viraktamath*)); 2♀, 1♂, Bhagamandala, 30.i.1983, (*Shashidhar*); 2♀, 4♂, Jog Falls, 534m, 8.v.1976 (1♂ (*Mallik*)); 16.xi.1976 (1♂ (*Mallik*)), 20.xii.1983 (1♂ (*Viraktamath*)), 3.xii.1992 (2♂, 1♀ (*Murthy*)); 1♀, Kodyamale nr Bantval, 28.xi.1984 (*Viraktamath*); 1♂, Subramanya, SF, nr Mangalore, 25.xi.1984 (*Viraktamath*); 1♀, Nandi Hills, 1467 m, 4.vi.1978 (*Viraktamath*); 1♂, 5 Km W Koppa, 29.xi.1982 (*Murthy*); Tamil Nadu: 1♀, Bolampatti valley, Coimbatore Dist. 20.iv.37; 2♀, Kodaikanal (*Campbell*); 3♂, 4♀, Yercaud, 18–21. ix.1978 (*Viraktamath*); 1♀, 9–10 Km S. Yercaud, 21.ix.1978 (*Viraktamath*), 1♂, Cinchona, 1062 m, 15.iv.1981 (*Kumar*); 1♂, Cinchona, 3500 ft (1062 m) iv/v.1957 (*Nathan*); Kerala: 1♂, Maraiyur, 1066 m, 24.iii.1977 (*Mallik*); 1♂, Thekkadi, 27.iii.1977 (*Viraktamath*) (BMNH, NPC, IRSNB, NMNH, UAS, ZSI).

REMARKS. The transverse black stripe on the vertex, medially elongate head and peculiar male genitalia are distinctive for this species. It differs from *crypta* and *transversa* Zhang and Webb in the shape of the apophysis of the style which is slender with a subapical tooth in *striata* whereas it is stouter and without a subapical tooth to the shaft in *crypta* and *transversa*.



***Kutara crypta* sp. n.**

(Figs 225–231)

DESCRIPTION. Male 6.50 mm long, 2.00 mm wide across eyes. Female 7.10 mm long, 2.30 mm wide across eyes. Coloration and structure similar to *striata*.

Male pygofer caudodorsally conically rounded, longer than height. Valve triangular. Subgenital plate much longer than pygofer, caudally upturned, triangular, 2.1× as long as broad at base. Style broad at base, with much broader apophysis compared with that in *striata*, rather straight till midlength then laterally curved. Connective with stem longer than arms. Aedeagus as in *striata* but shaft longer, with more slender apical prolongation, without subapical tooth.

MATERIAL EXAMINED (3 specimens)

Holotype♂, **Burma**: Lower Burma, Mergui (*Doherty*) (BMNH).

Paratypes: 1♂, same data as holotype; 1♀, **Burma**: Myitta (*Doherty*) (BMNH).

REMARKS. See *striata*.

***Kutara transversa* Zhang and Webb**

(Figs 232–235)

*Kutara transversa* Zhang and Webb, 1996:16.

Holotype♂, **SRI LANKA** (BMNH) [not examined].

MATERIAL EXAMINED (3 specimens)

Paratypes: **Sri Lanka**: 3♀, Kandy, vii–viii, 1902 (BMNH).

REMARKS. Zhang and Webb (1996) have given an adequate description of this species. *K. striatus*, *transversa* and *crypta* form a homogenous cluster related by their similarly shaped aedeagus terminating in a prolonged process. However, they differ in the shape of the male pygofer and apophysis of the style.

***Kutara brevipilata* sp. n.**

(Figs 236–244)

DESCRIPTION. Male 5.9 mm long, 2.12 mm wide across eyes. Female 7.3 mm long, 2.6 mm wide across eyes. Ochraceous. Vertex yellow, a transverse stripe interrupted by an oblique line a short distance on either side of median line chocolate brown. Upper part of face bordered by yellow apically with a dorsal brown margin. Anterior one-third of pronotum yellow, rest brown with ochraceous maculae. Scutellum pale brown with one median and three lateral longitudinal brown stripes (Fig. 236). Forewing veins dark brown, cells with a median faint brown stripe. Femora and tibiae ochraceous with longitudinal

brown fasciae on lower surface, bases of hind tibial spines brown. Vertex longitudinally striate, polished, impressed both medially and laterally, 4.7–5.5× as wide as median length, medially longer than next to eyes. Face shagreen, ocello-ocular area transversely rugulose. Pronotum transversely striate in posterior two-thirds, polished, 2.3× as wide as long. Scutellum shagreen in anterior half, longer than pronotum.

Male genital capsule depressed, ventral margin of pygofer roundly expanded, caudal margin concave, finely serrate, ventrocaudally lobate. Anal tube broad basally. Subgenital plate devoid of stout setae, short, about half as long as wide, almost semicircular. Style without subapical lobe, apophysis with rounded apex, surface rugulose. Connective stem twice as long as arms. Aedeagus with dorsal apodeme well developed, triangular, shaft tubular, caudodorsally curved, with large apical gonopore, a pair of basal elongate processes running close to shaft and diverging laterally at three-quarters, a median elongate apical process to shaft projecting beyond apex of shaft.

Female with hind margin of sixth sternum straight. Hind margin of seventh sternum deeply concave, visible only as a short band in lateral aspect, with lateral ribbon-like posterior prolongation reaching apex of eighth tergite, eighth sternite exposed as transverse bands.

MATERIAL EXAMINED (2 specimens)

Holotype♂, **India**: Mizoram: Lunglei, 22.xi.1981 (*Wesley*) (UAS).

Paratype: 1♀, same data as holotype (UAS).

REMARKS. This species is unique among *Kutara* in having very short subgenital plates, the aedeagus with basal processes to the shaft, the style without a subapical lobe and the female with a deeply concave seventh sternum with ribbon like caudolateral prolongation.

***BHATIA* Distant, 1908**

*Bhatia* Distant, 1908: 357; Zhang & Webb, 1966: 12.

Type species: *Eutettix olivacea* Melichar, by original designation.

REMARKS. This genus and the two species included from the study area have been described by Zhang and Webb (1996). They treated *Melichariella* Matsumura and *Koreanopsis* Kwon and Lee as junior synonyms of *Bhatia*, thus extending the distribution of the genus from Sri Lanka to the South East Palearctic and Austro-Oriental region.

**Key to species of *Bhatia* from the Indian sub-continent**

- 1 Apophysis of style bilobed, outer lobe beak-like (Fig. 246); intermediate sclerite between connective and

- aedeagus absent; shaft with ventral angular projection when viewed laterally, with a pair of lateral processes subapically (Figs 247, 248) ..... *olivacea* (p.171)
- Apophysis of style not bilobed, obliquely truncate (Fig. 249); intermediate sclerite between connective and aedeagus present (Fig. 250); aedeagus short, robust, not angled on its ventral margin, with apical process (Fig. 251) ..... *distanti* (p.171)

***Bhatia olivacea* (Melichar)**

(Figs 245–251)

*Eutettix* ? *olivacea* Melichar, 1903: 191–192, pl. 6, fig. 1, a–c. Holotype ♀, SRI LANKA (MMB) [not examined].

*Bhatia olivacea* (Melichar); Distant, 1908: 357; Zhang and Webb, 1966: 12, Figs 3, 7, 37, 62, 63, 71, 105–111, 483.

MATERIAL EXAMINED (3 specimens)

**Sri Lanka:** 1♂, 2♀ (BMNH).

***Bhatia distanti* Zhang and Webb**

(Figs 249–251)

*Bhatia distanti* Zhang & Webb, 1966: 13, Figs 112–116, 484. Holotype ♂, SRI LANKA (BMNH) [examined].

MATERIAL EXAMINED (3 specimens)

Holotype ♂, 2 (abdomen missing) paratypes: **Sri Lanka** (BMNH).

REMARKS. Zhang and Webb (1996) described this species for the specimens misidentified by Distant (1908) as *B. olivacea*.

***KOTABALA* gen. n.**

Type species: *Kotabala adivveyai* sp. n.

DESCRIPTION. Brown with dark brown irregular markings on head and thorax. Forewing with brown spots on apex of clavus, on apices of claval veins, first m-cu cross vein basally and apical cross veins limiting subapical cells and outermost apical cell on costa. Head wider than pronotum, anterior margin rather rounded to face, with ill-defined rim with a series of transverse striae. Ocelli on margin placed a distance greater than own diameter from adjacent eye, partially visible from above. Vertex 1.44× longer medially than next to eyes, sides convex; apex broadly and angularly rounded; polished, with longitudinal striae medially which become oblique laterally and transverse anteriorly beyond transverse impressed line. Face wider than long, shagreen; in profile more or less convex; frontoclypeus broadened dorsally, lora large, clypeoclypellar sulcus prominent; clypellus narrowest slightly

beyond base, apically broad. Antennal pit deep, inner margin angularly rounded to frontoclypeus. Antennal ledge prominent. Pronotum about half as long as wide, side margins short, transversely striate, shagreen anteriorly. Scutellum about as long as pronotum, shagreen, transversely striate, posteriorly. Forewing with four subapical and four apical cells; first (inner) subapical cell open behind, second slightly constricted in middle, third broadened apically, a cross vein between claval suture and claval vein. Fore femora with a series of 12 fine setae distally on anterior surface. Hind femoral setae 2+2+1, hind tibial spinulation  $R_1$  18 ± 2,  $R_2$  10 ± 1,  $R_3$  18 ± 2; hind basitarsus with three platellae.

Male pygofer with anterior margin straight, without apodemes, pygofer lobe rounded caudally, with several macrosetae and a number of fine setae. Valve triangular, subgenital plate rather triangular, devoid of macrosetae, apex lobate and lightly sclerotized. Style robust, basal half brown, subapical lobe with a digitate process, apophysis elongate, slender with transverse striae. Connective Y-shaped, fused with aedeagus. Aedeagus with a ventral triangular plate produced into lateral bifurcate processes at distal end, shaft simple with a pair of apical processes, gonopore large, apical; dorsal apodeme poorly developed.

Female genitalia with second valvulae having two prominences before midlength, dorsal teeth prominent, extending approximately one-third length. Seventh sternum with inner membranous area.

REMARKS. *Kotabala* is related to *Omanella* as both have a fused connective and aedeagus and a ventral extension to the aedeagus. However, it differs from *Omanella* in having a more elongate ventral extension to the aedeagus, a simple aedeagal shaft, in lacking basal paired processes, and in the second pair of valvula having two basal dorsal prominences which are absent in *Omanella*. *Kotabala*, *Omanella* and *Indokutara* probably form a closely related group of genera.

***Kotabala adivveyai* sp. n.**

(Figs 252–264)

DESCRIPTION. Male 4.80 mm long, 1.52 (1.50–1.55) mm wide across eyes. Female 5.3 (5.20–5.50) mm long, 1.7 (1.67–1.75) mm wide across eyes. Brown. Vertex with transverse chocolate brown stripes as in Fig. 252. Face ochraceous, lower part of lora and clypellus brown. Pronotum and scutellum mottled with chocolate brown.

Male pygofer lobe with caudal margin rounded with short stout setae along margin. Subgenital plate with microsetae laterally, more numerous on apical membranous lobe. Style rather robust, apophysis with tooth on mesal margin apically. Connective with stem 1.33×



as long as arms, apex of stem appearing bifid and fused with aedeagus. Aedeagus robust, shaft ventrally enclosed by a triangular plate, laterodistal angles with a pair of anteriorly directed bifid process; preatrium well developed; shaft short, caudodorsally curved with a pair of laterally directed processes at apex; dorsal apodeme poorly developed.

Female seventh sternum four times as wide as long, hind margin concave with a series of short lines along hind margin. Second valvula with dorsal teeth closely spaced without serration between them, teeth becoming smaller distally.

#### MATERIAL EXAMINED (15 specimens)

Holotype ♂, **India:** Karnataka, Kodyamale (near Bantval), 18.i.1984 (*Viraktamath*) SV 278 (UAS).

Paratypes: **India:** 2♂, 2♀, data as holotype, 4♀, data as holotype but 13.i.1984 (3♀) and 16.i.1984; 3♂, 1♀, Hebri (31 km N. Udupi), 11.i.1984 (*Viraktamath*); 1♀, Kollur, 8.i.1984 (*Viraktamath*); 1♀, Jog Falls, 534 m, 4.v.1976 (*Mallik*) (BMNH, NPC, NMNH, UAS).

REMARKS. *K. adiveyyai* resembles *Carvaka synavei* in its rather similarly coloured vertex, but its forewings are paler, its body more slender and its head rather rounded to front rather than angular as in *C. synavei*. It has been collected in the same localities as *Indokutara conica*.

### INDOKUTARA gen. n.

Type species: *Indokutara conica* sp. n.

DESCRIPTION. Ochraceous with greenish tinge. Forewing with a small brown spot on apex of clavus, claval veins, cross veins limiting cells brown. Head wider than pronotum, anterior margin rounded to front, with a series of transverse striae; ocelli on anterior margin of head placed a distance greater than own diameter from adjacent eye, partially visible from above. Vertex 1.30–1.44× as long medially as next to eyes; sides convex, mediolongitudinally and laterally obliquely striate, striae becoming transverse beyond transverse impressed line. Face wider than long, shagreen, upper surface convex in profile; clypellus broadened apically; antennal pits deep, ledge prominent. Pronotum about twice as wide as long, side margins short, carinate; transversely striate, anteriorly shagreen. Scutellum about as long as pronotum, shagreen, transversely striate in posterior half. Forewing with a cross vein between claval veins and claval suture and outer claval vein, subapical and apical cells four; inner subapical cell open behind, second narrowed slightly in middle, third widened caudally. Fore femora with 14–15 fine setae. Hind femoral spinulation 2+2+1, hind tibial spinulation  $R_1$  20±2,  $R_2$  10±1,  $R_3$  13±2. Three platellae on apical

transverse row of hind basitarsus.

Male pygofer with anterior margin straight, with a small apodeme laterally; pygofer lobe with numerous macrosetae and microsetae; ventral margin not expanded. Valve strap-like, with straight anterior margin. Subgenital plate with a transparent brown spot near base, triangular, with long fine scattered setae. Style slender, subapical lobe well developed, apophysis broad and short, with strong sculpturing on surface. Connective Y-shaped with a dorsal keel, fused with aedeagus, stem very long. Aedeagus simple without dorsal apodeme or preatrium, tubular, with a pair of apical processes, gonopore subapical, large.

Female genitalia with second valvulae having a basal and a median prominences, teeth on cutting edge decreasing in size distally, occupying less than half length.

REMARKS. *Indokutara* externally resembles *Omanella*. It also shares the character of fused aedeagus and connective with it and with *Kotabala*. However, it differs from both in lacking the caudal extension of connective beyond the fusion with the aedeagus. The claval veins in *Indokutara* are connected by a cross vein as in *Kutara*. The second pair of valvula have one basal and one median prominence which are lacking in *Omanella*.

In addition to the type species described below, there is another species of the genus represented just by a female from Kollur (Karnataka) which has a much longer median prolongation of the hind margin of the seventh sternum and the pedicel of the antenna chocolate brown.

### *Indokutara conica* sp. n.

(Figs 265–276)

DESCRIPTION. Male 4.60 (4.40–4.80) mm long, 1.50 (1.47–1.62) mm wide across eyes. Female 5.40 (5.20–5.50) mm long, 1.75 (1.67–1.82) mm wide across eyes. Ochraceous with greenish tinge. Pronotum and scutellum with a few pale brown markings.

Male pygofer narrowed caudally with conically rounded lobe, with several macrosetae and hair-like setae, latter more numerous and scattered at the base of lower part of pygofer, ventral margin rather straight. Subgenital plate elongate, triangular, 2.2× as long as broad at base, apical half covered with scattered thin setae, basal half with finer setae along lateral margin. Style broad at base, subapical lobe well developed, apophysis short, broad, thickly sculptured. Connective elongate, stem twice as long as arms, intimately fused with aedeagus, with a dorsal median keel running entire length. Aedeagus with shaft directed posteriorly in basal two-thirds then curved dorsally; gonopore

apical, large, surrounded laterally by a triangular plate-like process on either side.

Female seventh sternum 3.5× as wide as its median length, hind margin medially prolonged into a bilobed process. Second pair of valvula with dorsal teeth prominent, proximal four teeth more widely spaced than remaining teeth.

#### MATERIAL EXAMINED (11 specimens)

Holotype♂, **India**: Karnataka, Kodyamale (near Bantval), 13.i.1984 (*Viraktamath*) SV 276 (UAS).

Paratypes: **India**: 3♂, data as holotype; 2♂, 2♀, data as holotype but 16.i.1984 (1♂, 1♀) and 28.xi.1984 (1♂, 1♀); 1♂, 2♀, Hebri, 31 Km N. Udupi, 11.ii.1984 (*Viraktamath*) (BMNH, NPC, UAS, NMNH).

REMARKS. This species may be confused as a species of *Bhatia* or *Omanella* as it has similar coloration. However, it can be easily recognised by its peculiar male genitalia. Its known localities are the same as for *Kotabala adiveyyai*.

### OMANELLA Merino, 1936

*Omanella* Merino, 1936: 361; Zhang and Webb, 1996: 18–119. Type species: *Omanella barberi* Merino, by original designation.

REMARKS. Zhang and Webb (1996) redescribed this genus which can be easily recognised by the brown spots on the dorsum, long ovipositor, aedeagus fused to midlength of connective and modified style. The single species, *johnsoni*, recorded from the study area (Sri Lanka and Burma) by these authors has been studied.

#### *Omanella johnsoni* Merino

(Figs 277–280)

*Omanella johnsoni* Merino, 1936: 363, Pl 3, Figs 4a–d; Zhang and Webb, 1996: 19, Figs 256–263, 494. Holotype♂, PHILIPPINES (NMNH) [not examined].

#### MATERIAL EXAMINED (2 specimens)

**Burma**: 2♀, base of Downa Hills (BMNH).

REMARKS. Specimens of this species from Sri Lanka were figured by Linnavuori and Al-Ne'amy (1983) as *Bhatia olivacea* Distant. The illustrations of this species provided by Zhang and Webb (1996) are reproduced here for ease of identification.

### NAKULA Distant, 1918

*Nakula* Distant, 1918: 39. Type species: *Nakula multicolor* Distant, by original designation.

DESCRIPTION. Olive green with prominent orange and black markings. Head wider than pronotum, very slightly shorter medially than next to eyes, fore-margin slightly angulately rounded to face, transversely striate. Face wider than long, shagreen, in profile slightly convex, ocelli placed slightly below fore margin, about three times their own diameter away from adjacent eye. Clypellus narrow medially, twice as wide apically as at base, wider than long; transclypeal sulcus present. Antennae situated fairly low on face below midheight of eye in facial view. Pronotum about twice as wide as long, rather convex, lateral margin short, carinate, transversely striate, shagreen anteriorly. Scutellum about as long as pronotum, shagreen. Fore wing with three anteapical cells, inner one open behind, outer one smallest. Hind femoral spinulation 2+2+1. Hind tibial spinulation R<sub>1</sub> 30, R<sub>2</sub> 13, R<sub>3</sub> 18. Hind basitarsus with three platellae.

Male pygofer longer than height, caudodorsal angle almost forming a right angle, caudoventral angle produced ventrally into a short process; caudodorsal area with a few long macrosetae, ventral margin convex. Subgenital plate elongate, abruptly narrowed at basal one-third, apical one-third finger-like, curved dorsally, a marginal row of short macrosetae in addition to hair-like setae. Style with apophysis broadened distally, both mesal and lateral angles lobe-like, surface striated. Connective Y-shaped, stem bifid distally, articulated with aedeagus. Aedeagus with dorsal apodeme well developed, shaft elongate, curved, distally bifid, gonopore large at basal one-third, opening on cephalic margin.

REMARKS. *Nakula* appears related to *Kutara*. Both have short heads although the former does not have a rimmed fore margin, and both have similar aedeagus structure. *Nakula* also differs from *Kutara* in being brightly coloured and in lacking a cross vein between the claval veins.

#### *Nakula multicolor* Distant

(Figs 281–289)

*Nakula multicolor* Distant, 1918: 39, Fig. 20; Zhang and Webb, 1996: 17–18, Pl. 1 Fig. 7 (habitus). Lectotype♀, BURMA (BMNH), designated by Zhang & Webb, 1996 [examined].

DESCRIPTION. Male 7.7 mm long, 1.03 mm wide across eyes. Olive green. Head with an orange band interrupted medially and on posterior margin near eyes, extending onto eyes and anteriorly towards face along inner margin of eye; a spot above ocellus, a larger spot on inner and outer areas of eye black. Lateral margins of genae broadly orange. Lateral angles of scutellum broadly orange with a triangular black spot. Forewing hyaline with brown tinge, inner



claval margin except along scutellum orange, basal one-third of outer claval vein orange, other veins brown. Mesosternum, mesoepipleural suture black, lateral margin mesepisternum broadly orange.

Structure and male genitalia as in generic diagnosis.

MATERIAL EXAMINED (2 specimens)

Lectotype ♀, **Burma**: Mergui (*Doherty*) (BMNH). **Thailand**: 1♂, Chiangdao, 5–11. iv. 1958 (*Maa*) (BPBM).

REMARKS. Only two species of *Paraboloponini* from the study area, namely *N. multicolor* and *R. egregia*, have bright orange spots. The former may be distinguished from the latter by its more extensive orange coloration with black spots, and by its much shorter head.

### **ROXASELLA Merino, 1936**

*Roxasella* Merino, 1936: 359; Zhang and Webb, 1996: 20. Type species: *Roxasella camusi* Merino, by original designation.

REMARKS. This mainly Pacific genus was redescribed by Zhang and Webb (1996), but they considered it to be poorly defined. Like *Nakula*, the species of *Roxasella* are also brightly coloured with orange markings, but have rather longer heads which are medially longer than next to eyes. A single species, *egregia* occurs in the study area.

#### ***Roxasella egregia* (Stål)**

(Figs 290–293)

*Selanocephalus egregaria* Stål, 1864: 66. Holotype ♀, BURMA (NRS) [examined].

*Roxasella egregia* (Stål), Zhang and Webb, 1996: 20, Fig. 505.

MATERIAL EXAMINED (1 specimen)

Holotype ♀, **Burma** (NRS).

REMARKS. The identity of this species, known only from the female, remains uncertain. Zhang and Webb (1996) state that Distant (1908, 1918) misidentified specimens of this species as *R. laetisigna* (Walker), a species identical externally to *egregia*. However, in the three known females of *egregia* the posterior margin of the seventh sternum is asymmetrically curved.

### **DRYADOMORPHA Kirkaldy, 1906**

*Dryadomorpha* Kirkaldy, 1906: 335; Webb, 1981: 49; Zhang and Webb, 1996: 14. Type species: *Dryadomorpha pallida* Kirkaldy, by monotypy.

*Paganalia* Distant, 1917: 314; Webb, 1981: 49. Type species: *P. virens* Distant, by monotypy.

*Zizyphoides* Distant 1918: 73; Webb, 1981: 49. Type

species: *Z. indicus* Distant, by original designation. *Rhombopsis* Haupt, 1927: 22; Webb, 1981: 49. Type species: *R. virens* Haupt, by monotypy.

REMARKS. This genus was redescribed by Webb (1981) who also established the above synonymies. A single wide spread species, *pallida*, occurs in the Indian subcontinent.

#### ***Dryadomorpha pallida* Kirkaldy**

(Figs 294–304)

*Dryadomorpha pallida* Kirkaldy, 1906: 36; Webb, 1981: 50–53, Figs 41–56; Zhang and Webb, 1996: 14, Pl 1, Fig. 18; Fig. 40. Holotype ♀, AUSTRALIA (BPBM).

*Zizyphoides indicus* Distant, 1918: 73. Lectotype ♀, INDIA (BMNH), designated by Webb (1981: 50). *Rhombopsis viridis* Pruthi, 1930: 34. Lectotype ♂, INDIA (ZSI), designated by Webb (1981: 50).

*Rhombopsis chatterjeei* Pruthi, 1934: 26. Lectotype ♂, INDIA (FRI), designated by Webb (1981: 50).

MATERIAL EXAMINED (12 specimens)

**India**: 7♂, 5♀, Karnataka (Bangalore, Chikballapur, Dharwar, Mudigere); Maharashtra (Dhond); Himachal Pradesh (Kulu); Tamil Nadu (Kotagiri) (UAS).

REMARKS. This species was redescribed by Webb (1981) who also established the synonymies above.

### **PAROHINKA Webb, 1981**

*Parohinka* Webb, 1981: 57; Zhang and Webb, 1996: 19. Type species: *Muirella longiseta* Melichar, by original designation.

REMARKS. This mainly Pacific genus was described by Webb (1981). It is similar in external appearance to *Dryadomorpha* but can be distinguished by the pale spots on the vertex and the asymmetrical aedeagus. A single widely spread species, *longiseta*, occurs in the study area.

#### ***Parohinka longiseta* (Melichar)**

(Figs 305–316)

*Muirella longiseta* Melichar, 1914: 135; Webb, 1981: 68, Figs 129–143; Zhang and Webb, 1996: 19, Figs 39, 477. Lectotype ♂, JAVA (MMB), designated by Webb, 1981 [not examined].

MATERIAL EXAMINED (3 specimens)

**India**: Karnataka: Devarayanadurg, 1♂, 8.vii.1979, ex *Ziziphus mauritiana* (Viraktamath); 1♀, Bannerghatta (nr. Bangalore), 22.x.1982 (Murthy); 1♀, 12–15

mi. SW of Hunsur, 18.i.1978 (*Viraktamath*) (UAS).

REMARKS. Webb (1981) redescribed this widespread species; his records from the Indian subcontinent include Nepal and North-east India (Darjeeling). It also occurs in south India.

**PARABOLOPONA Matsumura, 1912**

*Parabolopona* Matsumura, 1912: 288; Webb, 1981: 42; Zhang and Webb, 1996: 19. Type species: *Parabolocratrus guttatus* Uhler, by original designation.

REMARKS. This genus was redescribed by Webb (1981). It is represented in the study area by two females of an undescribed species from Nepal (Sarankot, 17.ix.1979, ex *Quercus* sp., grasses (*Dworakowska*) (UAS)) which is characterized by its having several cross veins between the outer claval vein and claval suture and having the outer anteapical cell subdivided.

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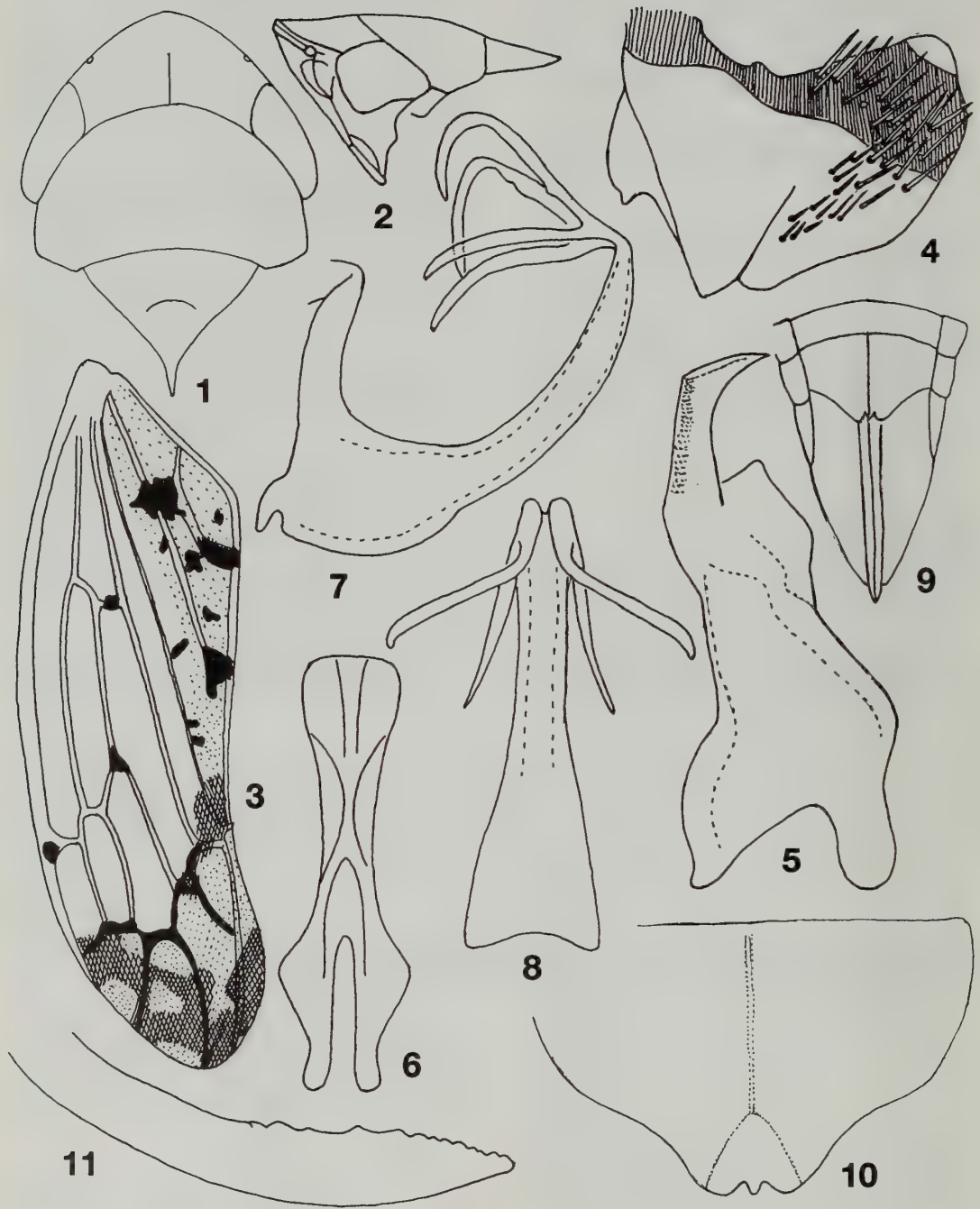
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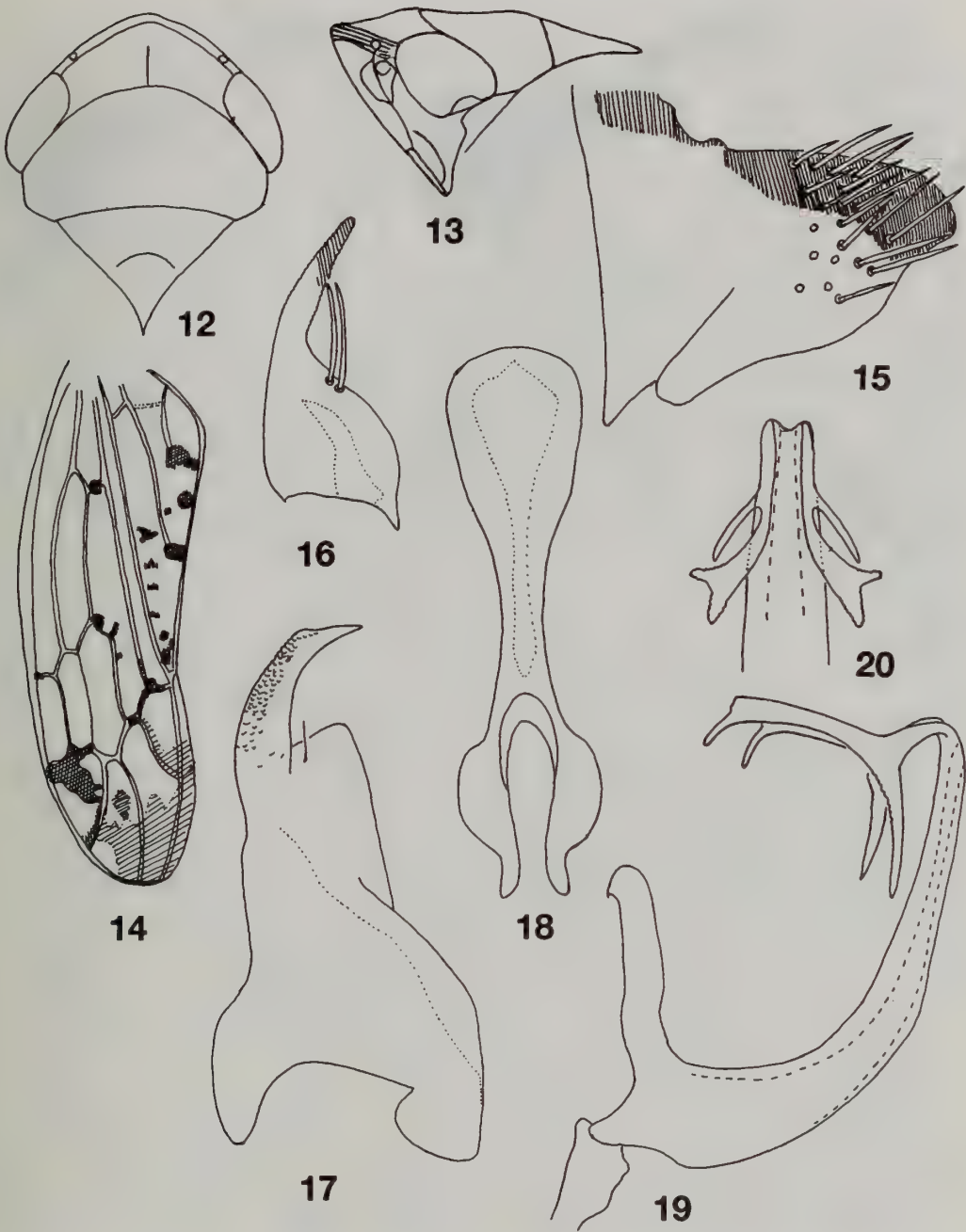
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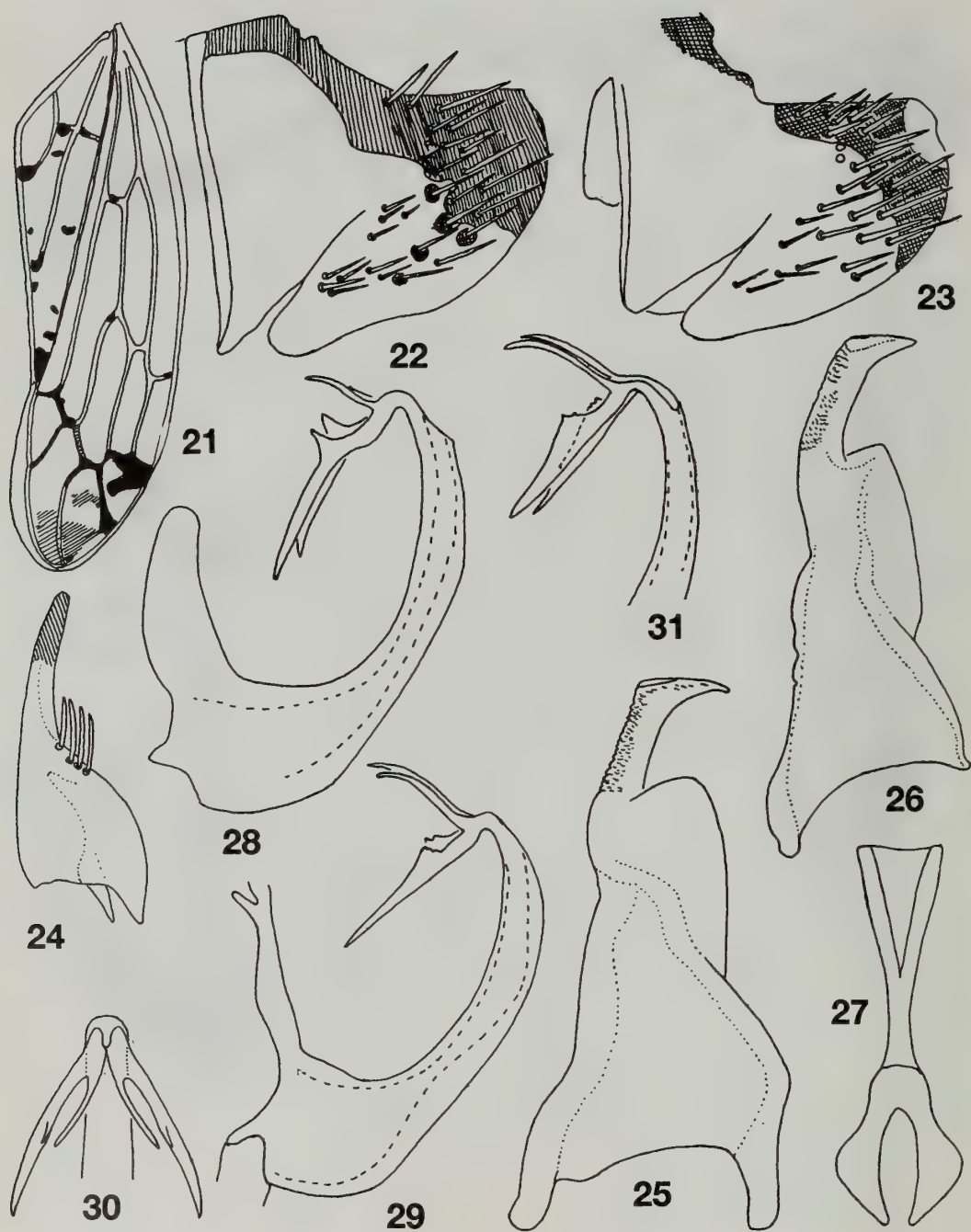


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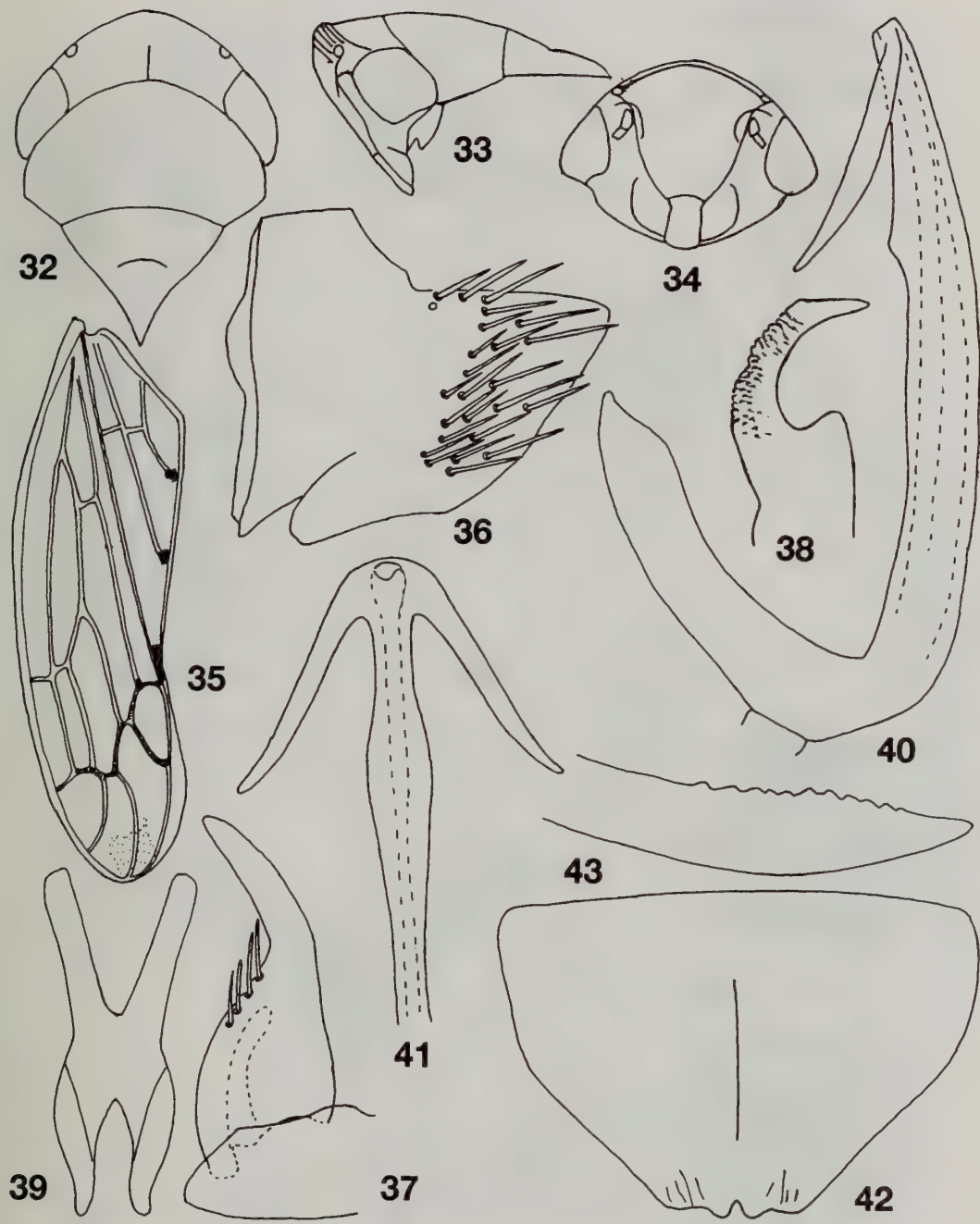


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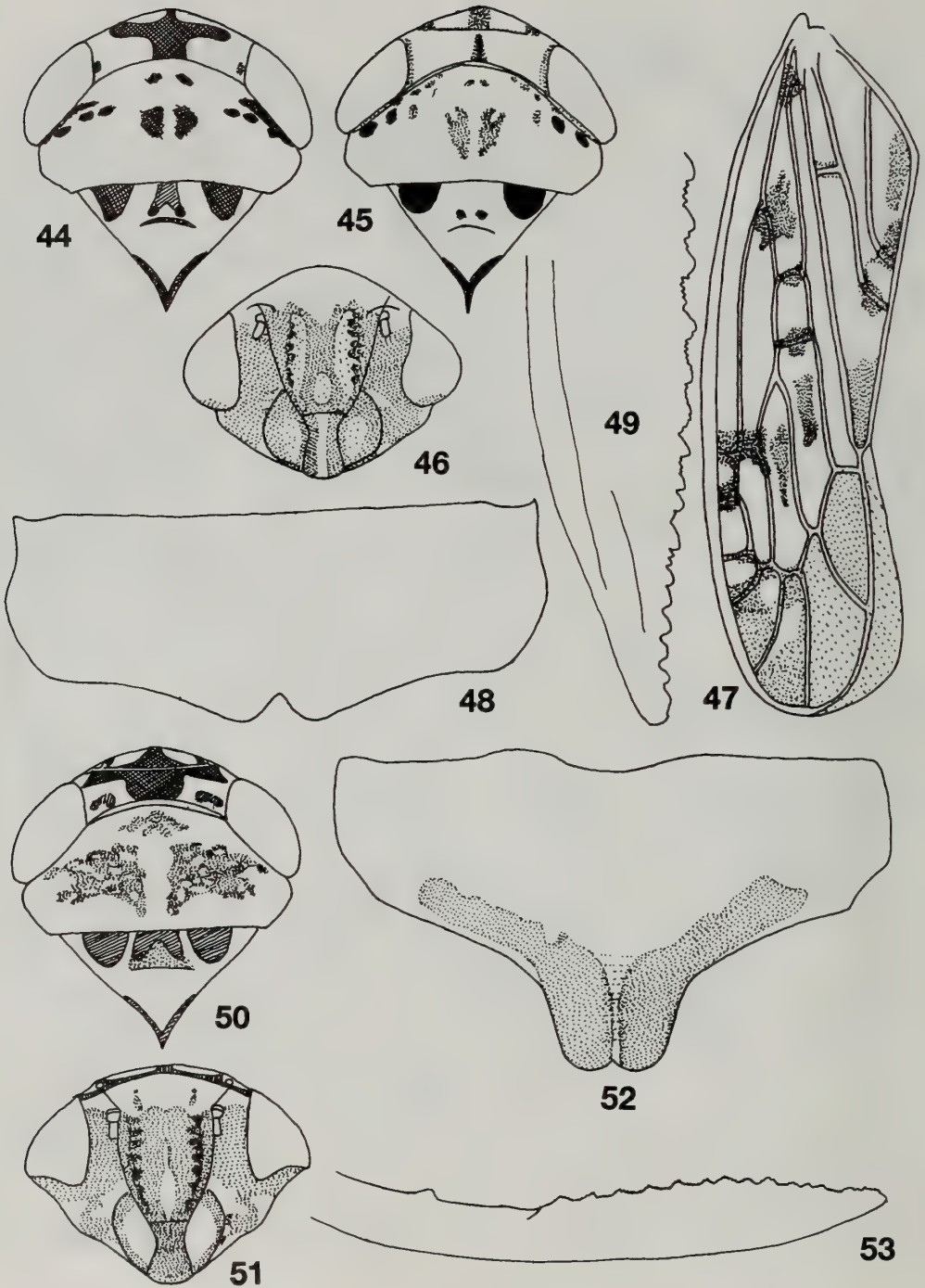


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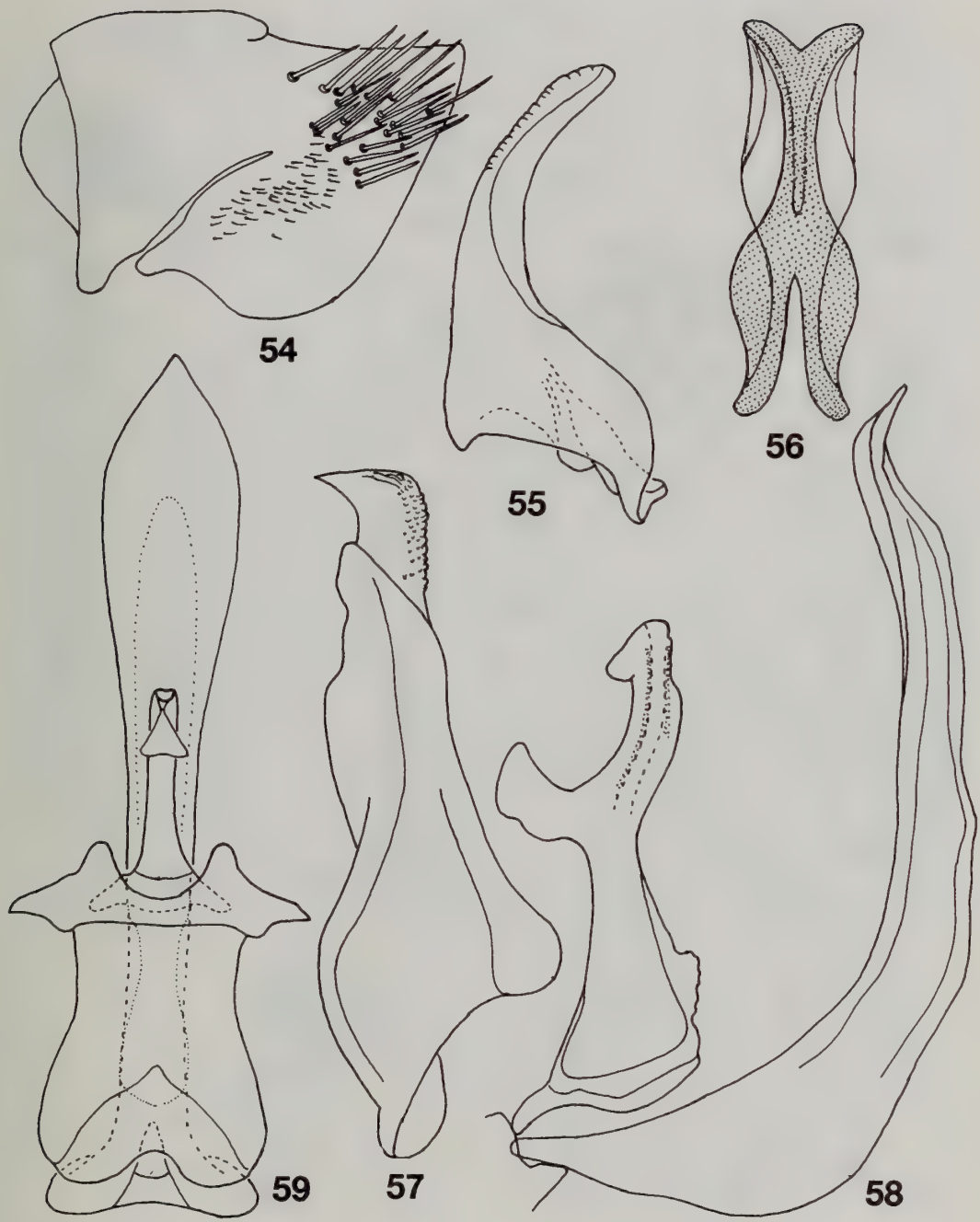
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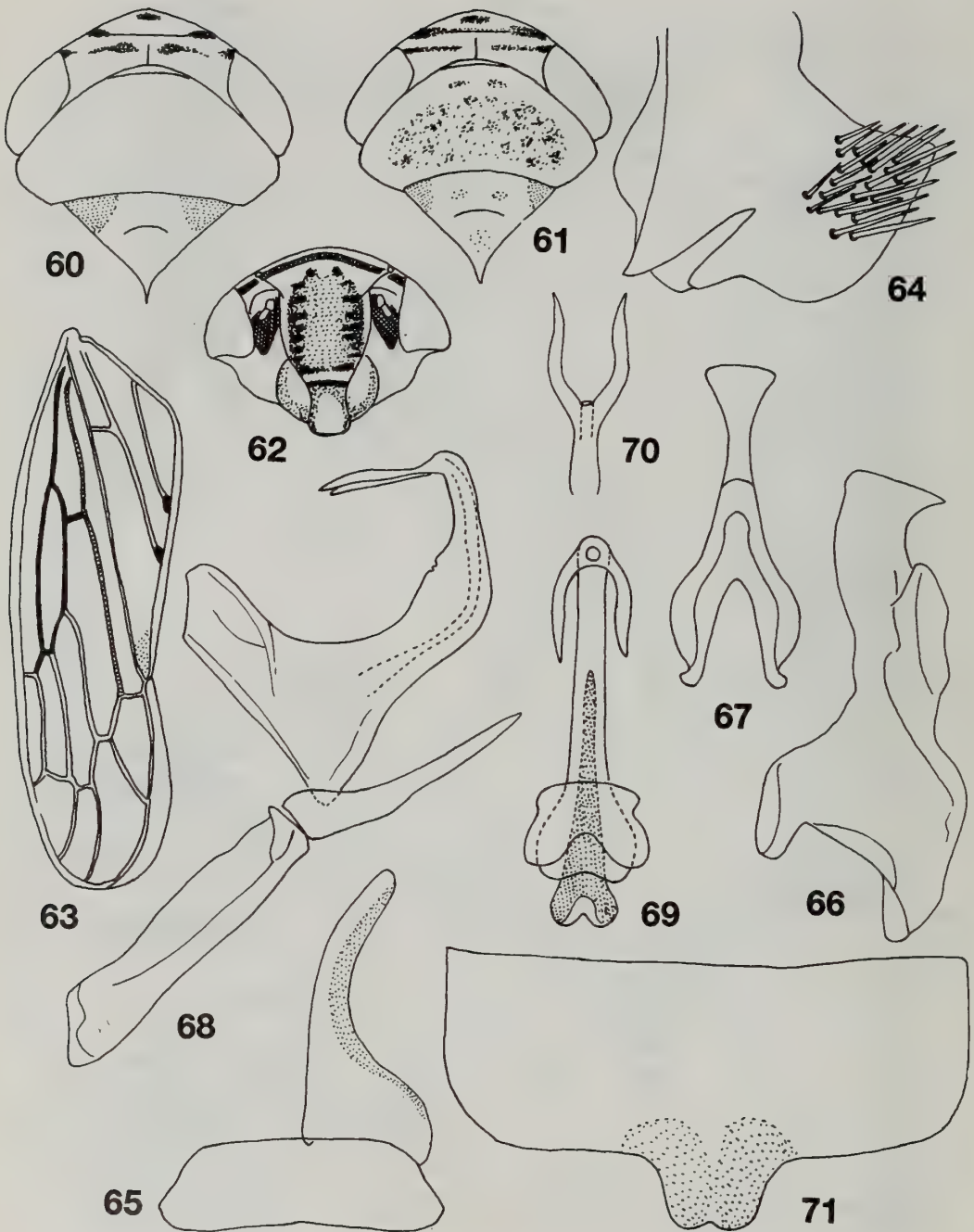
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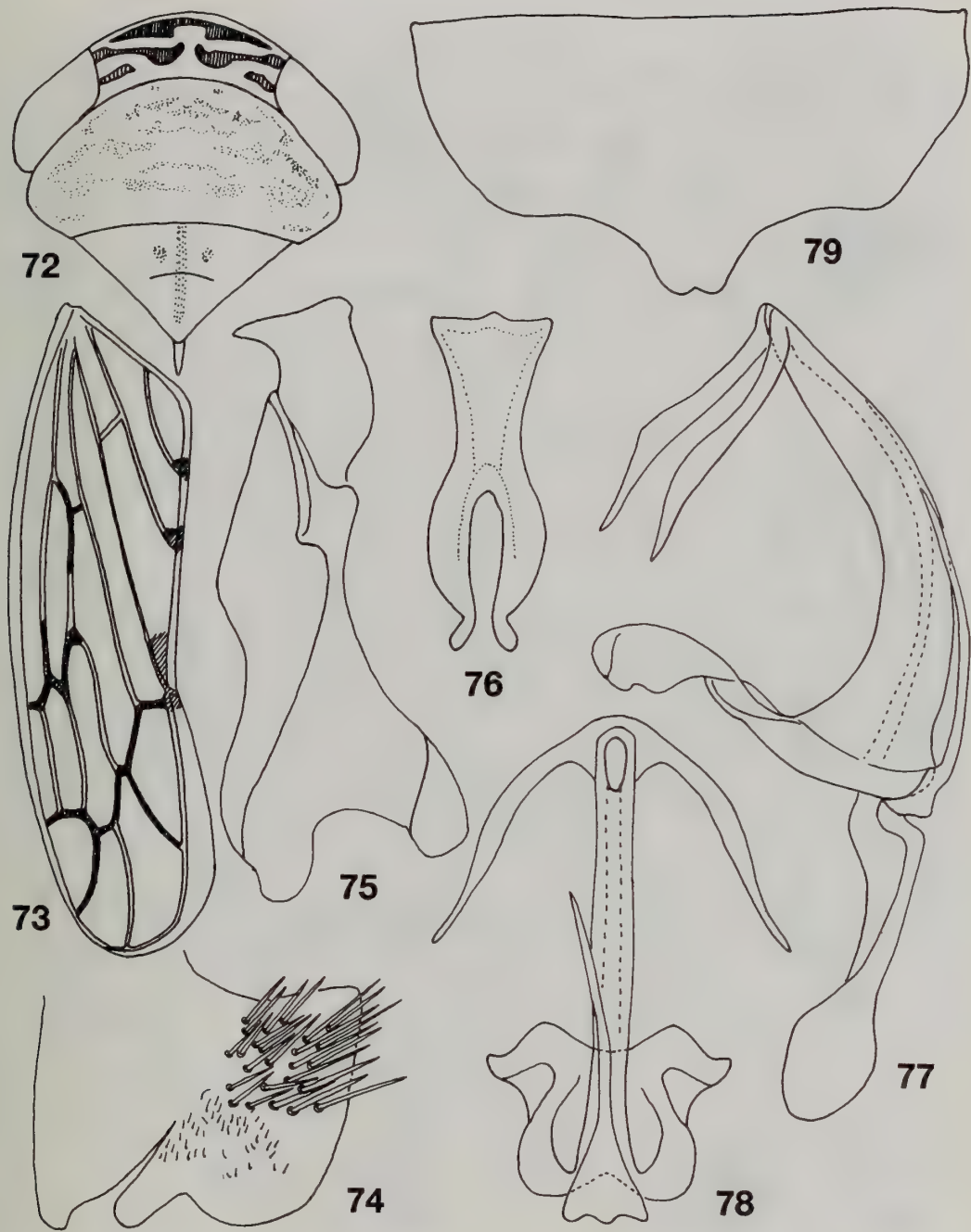


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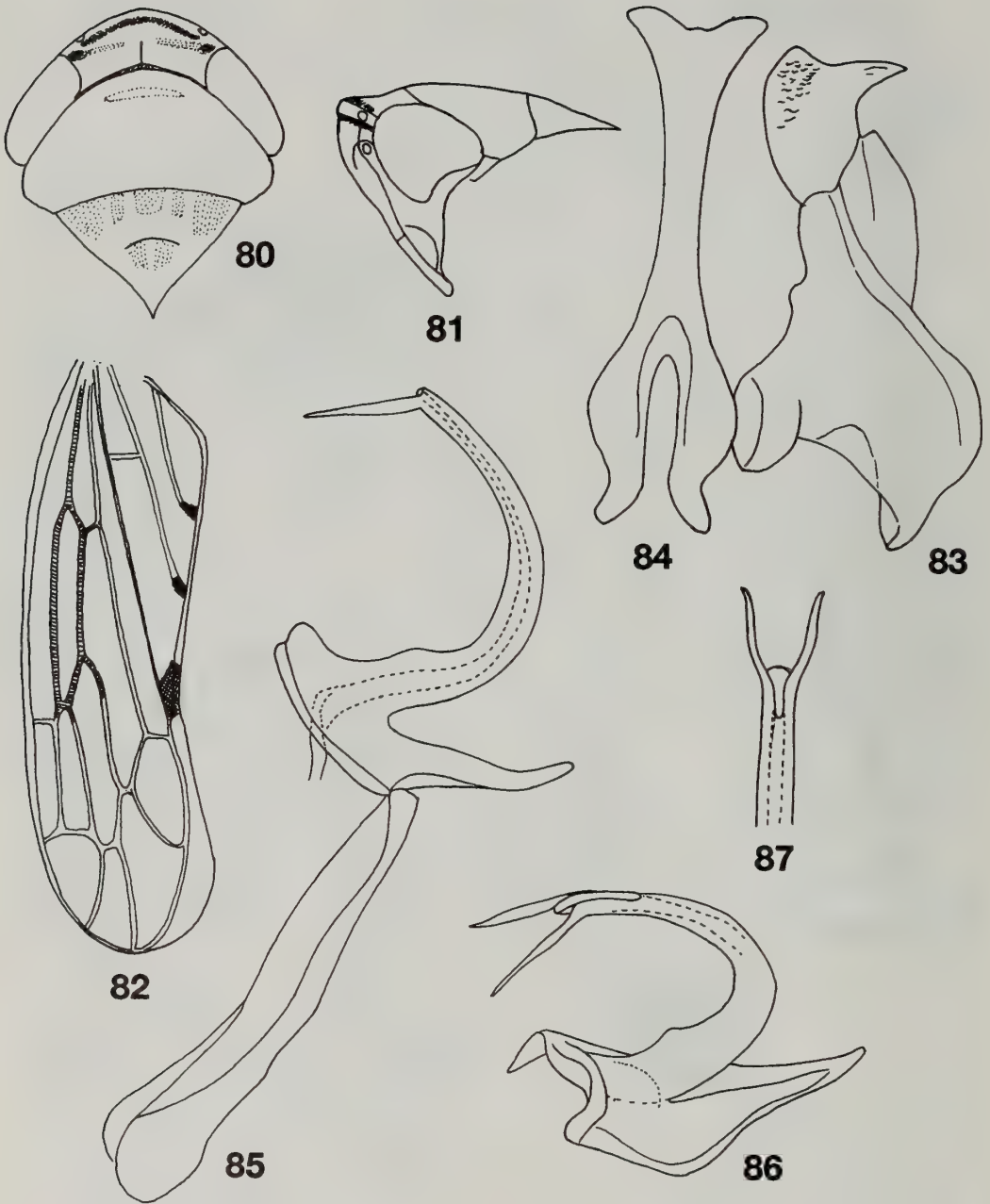


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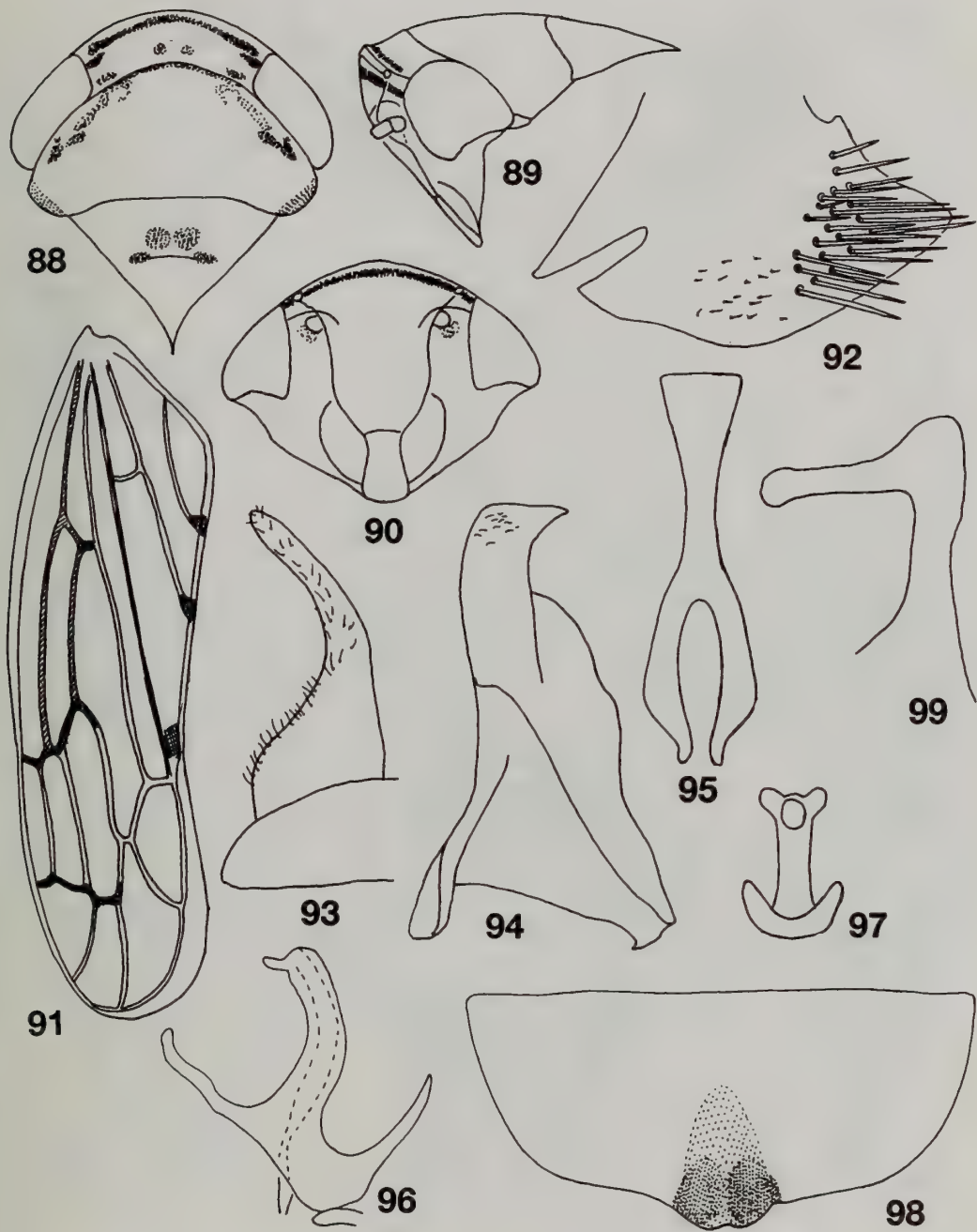


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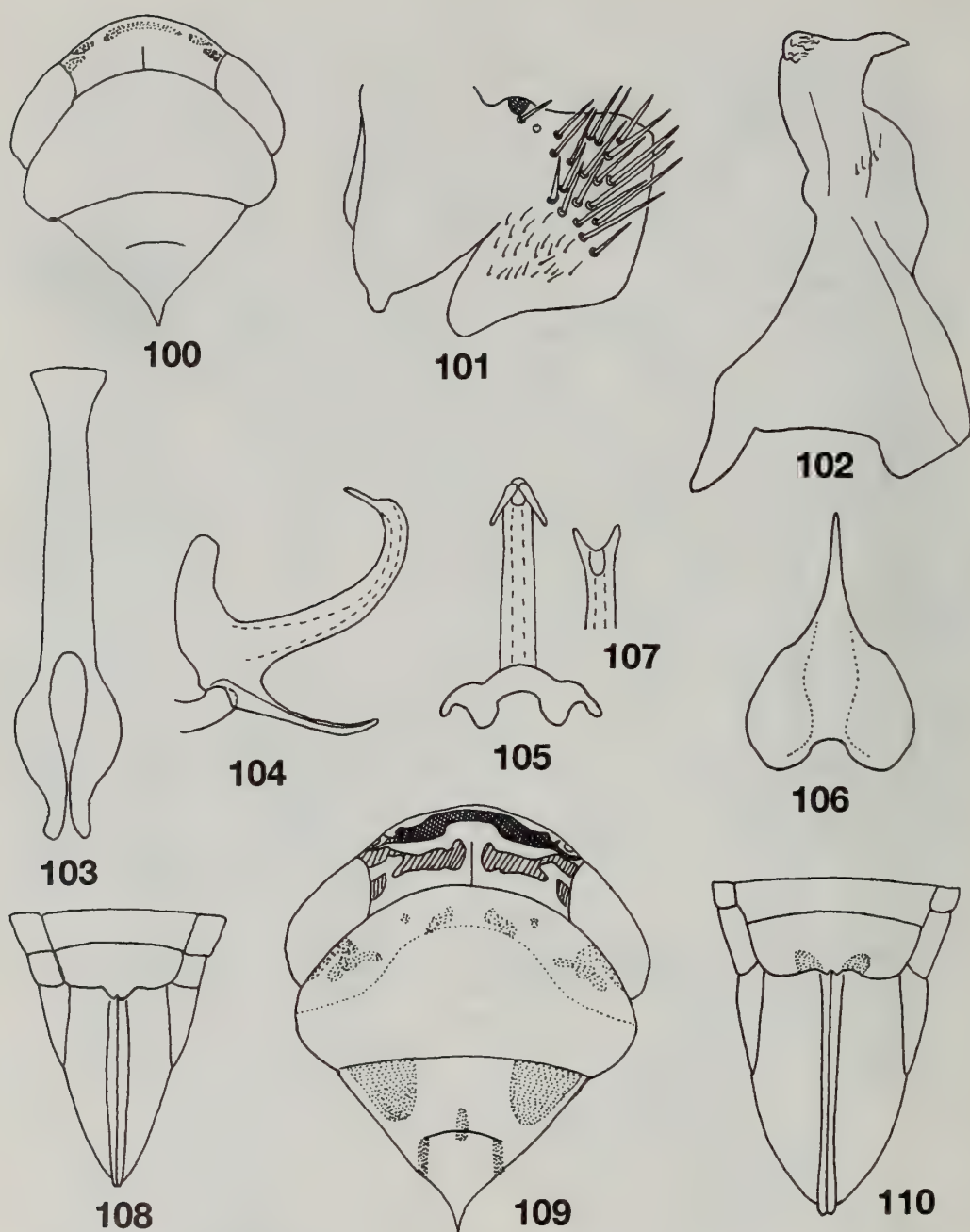


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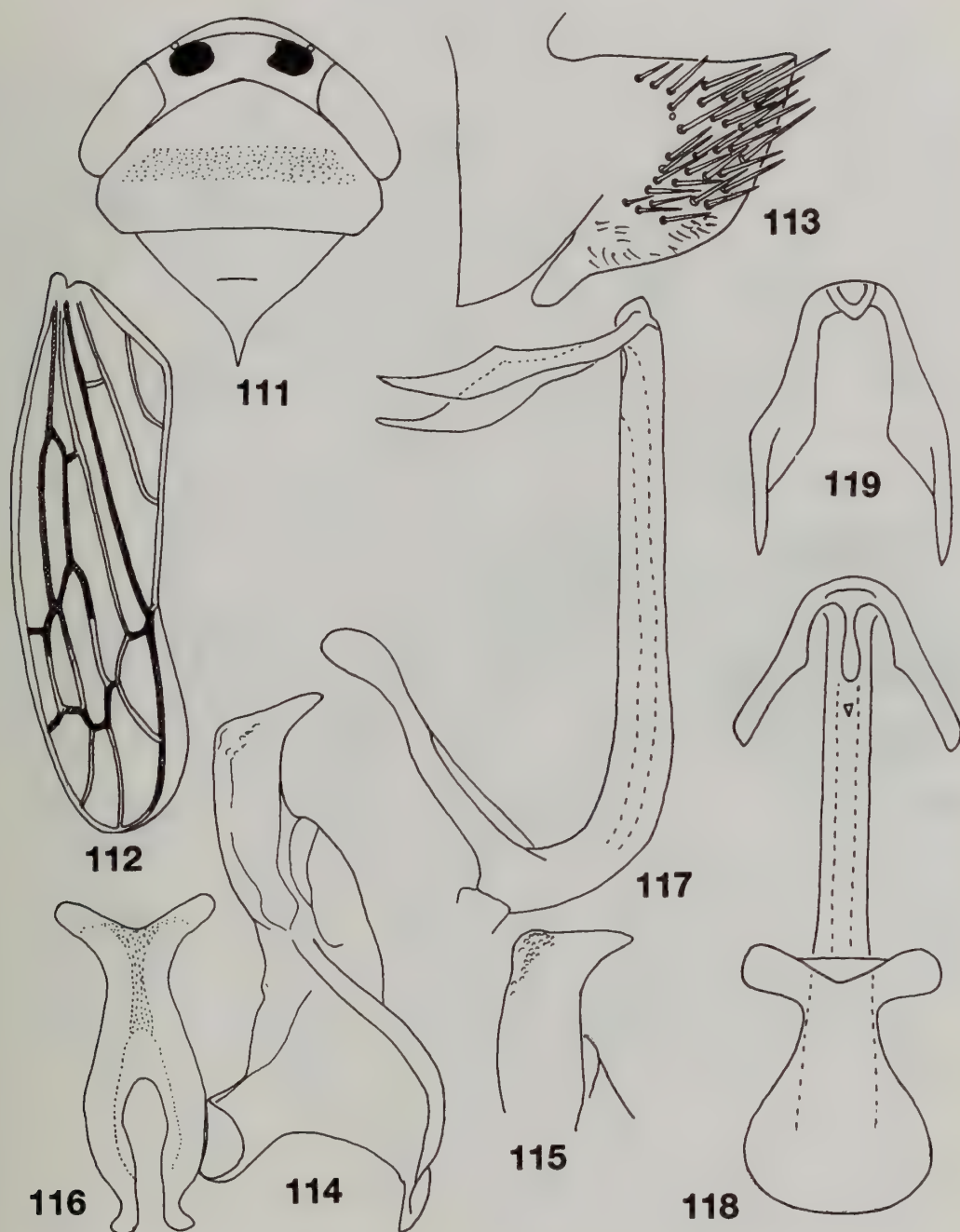


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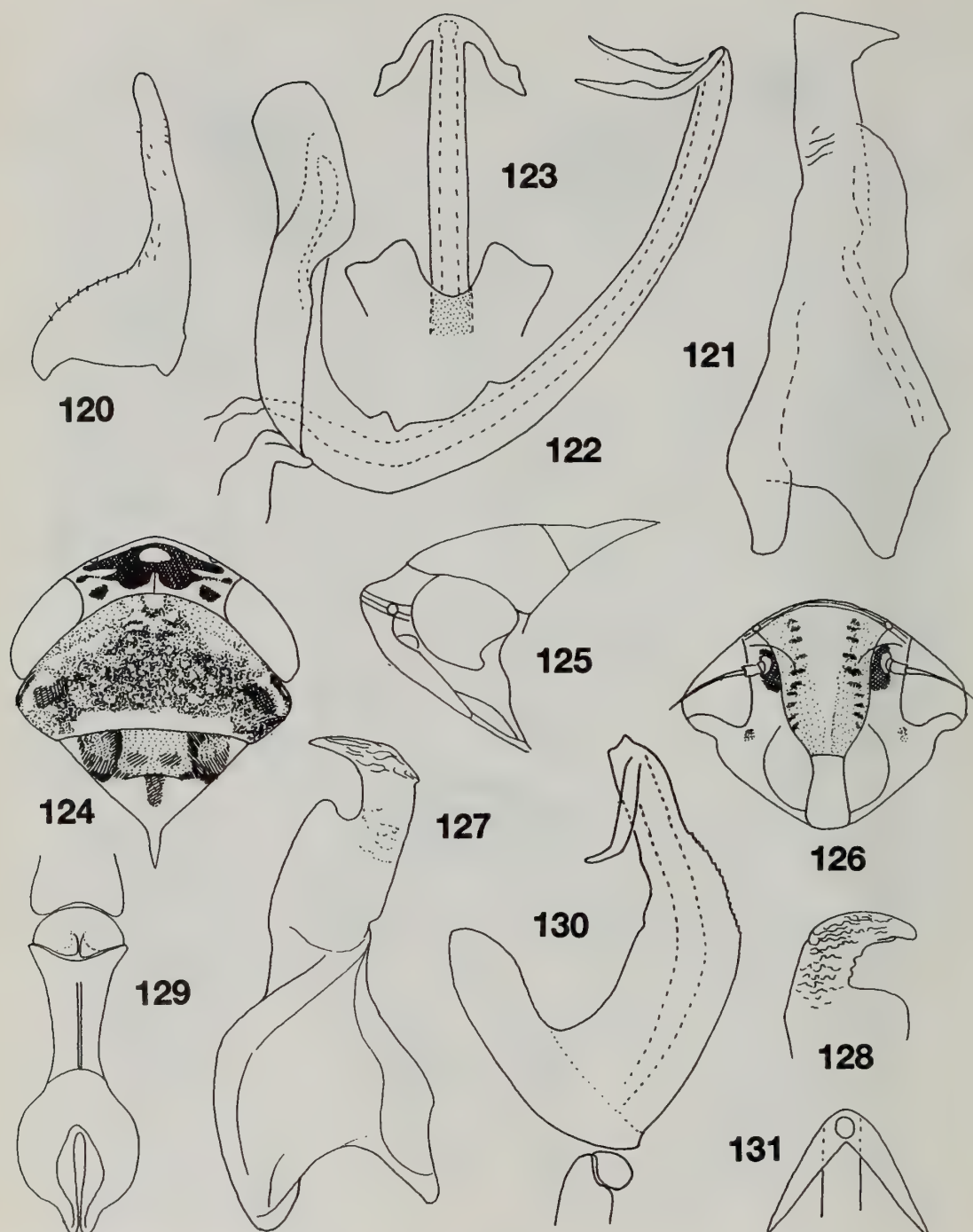


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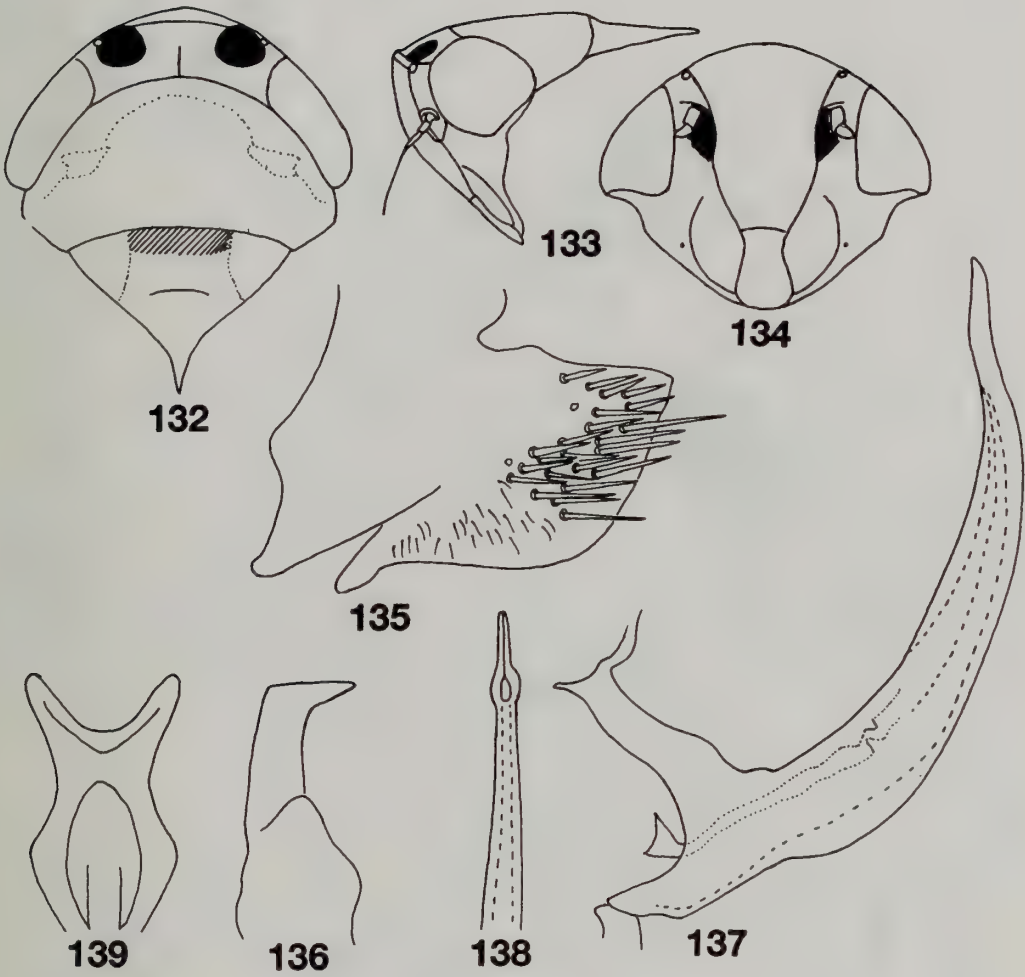


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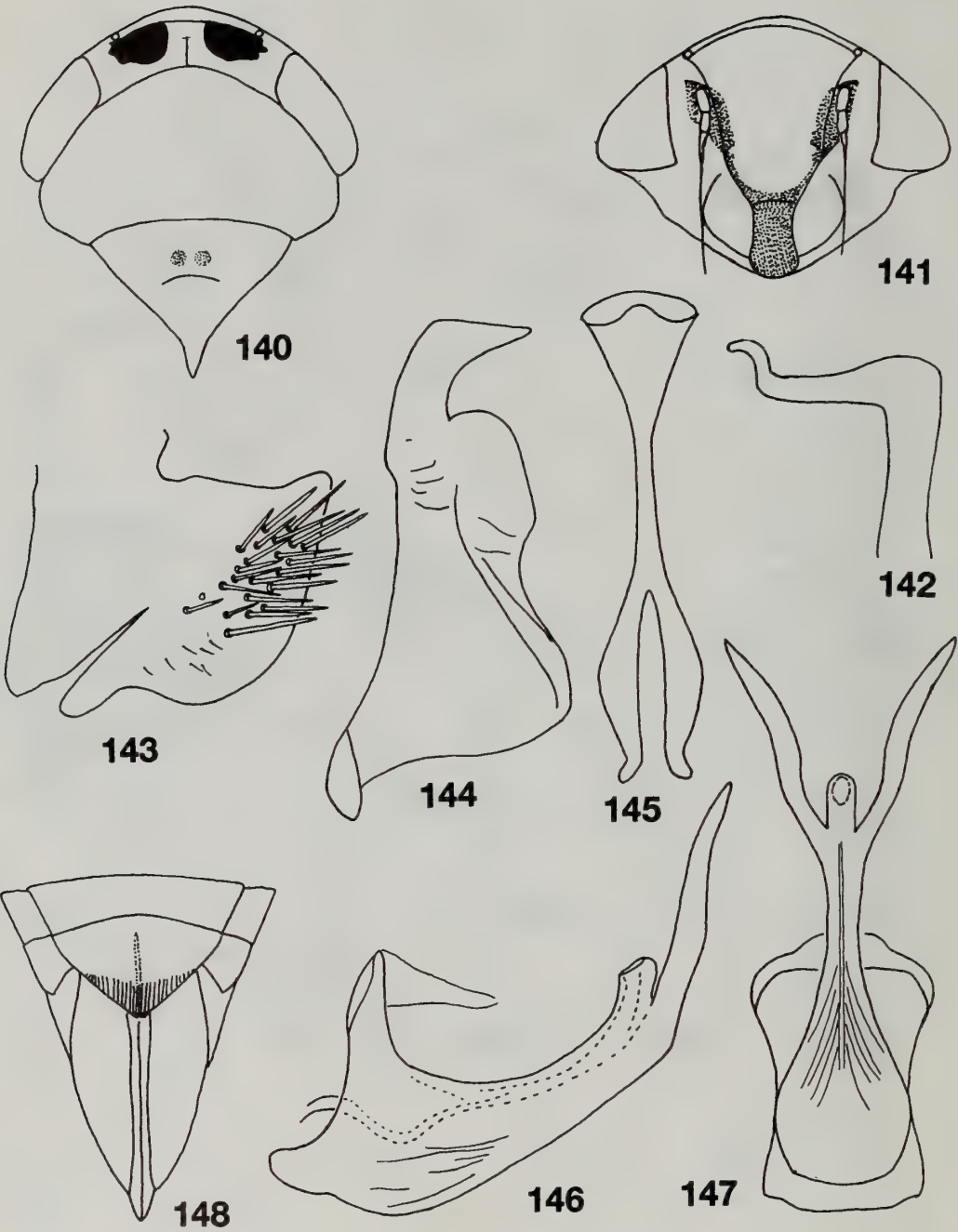


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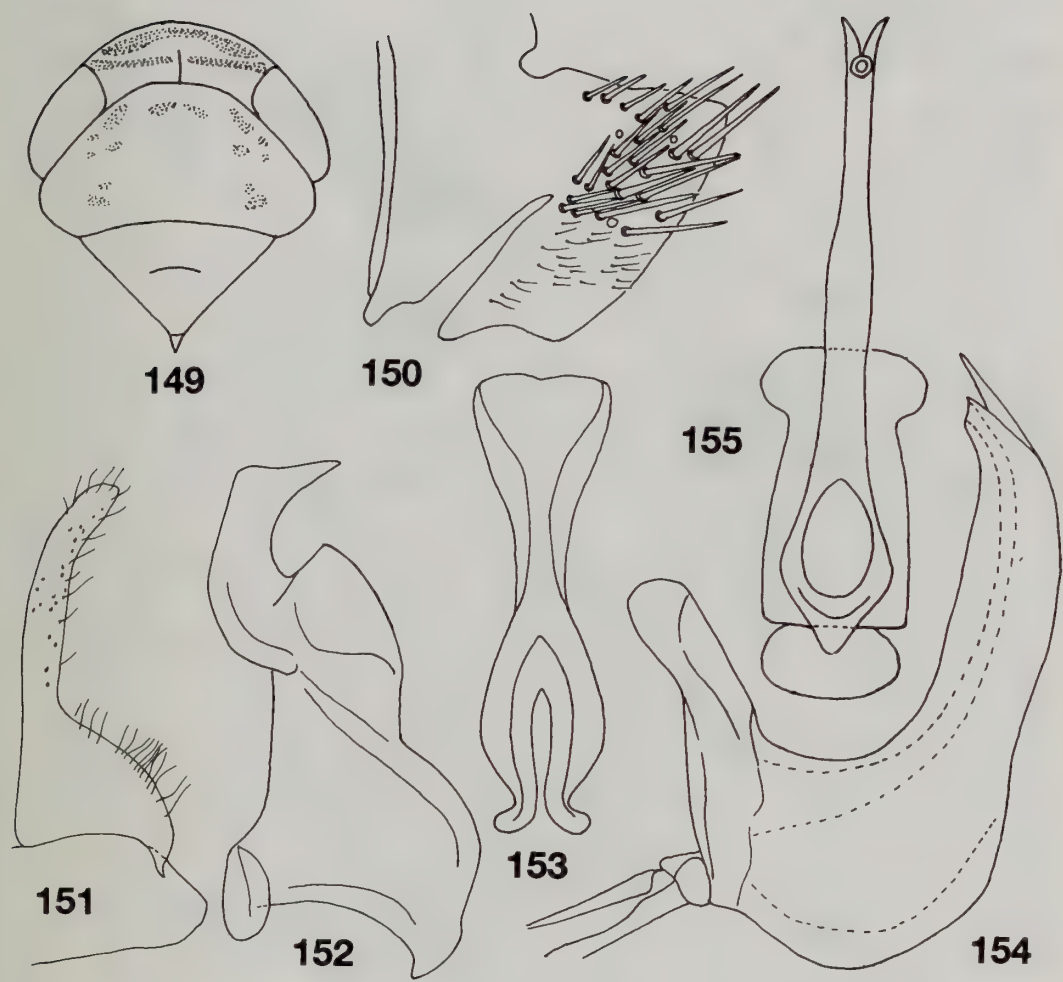


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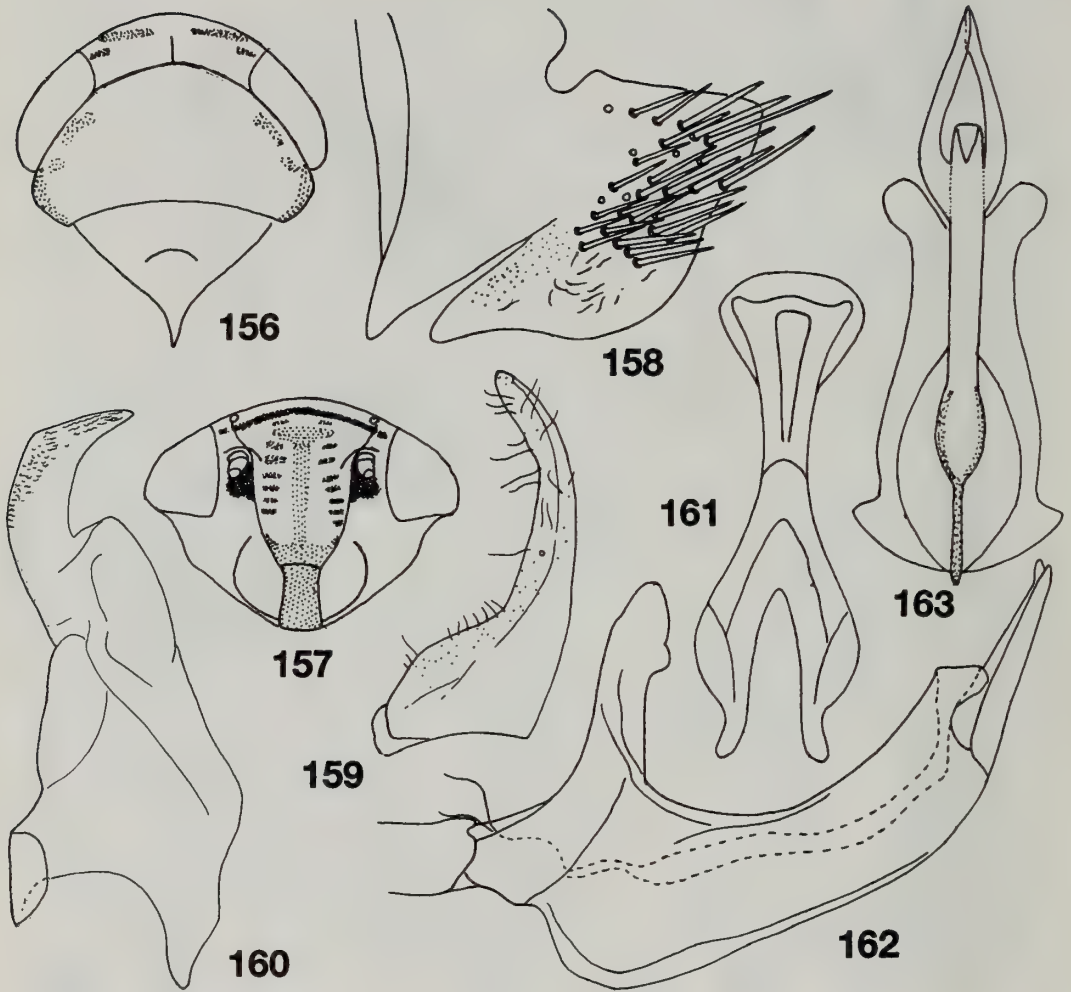


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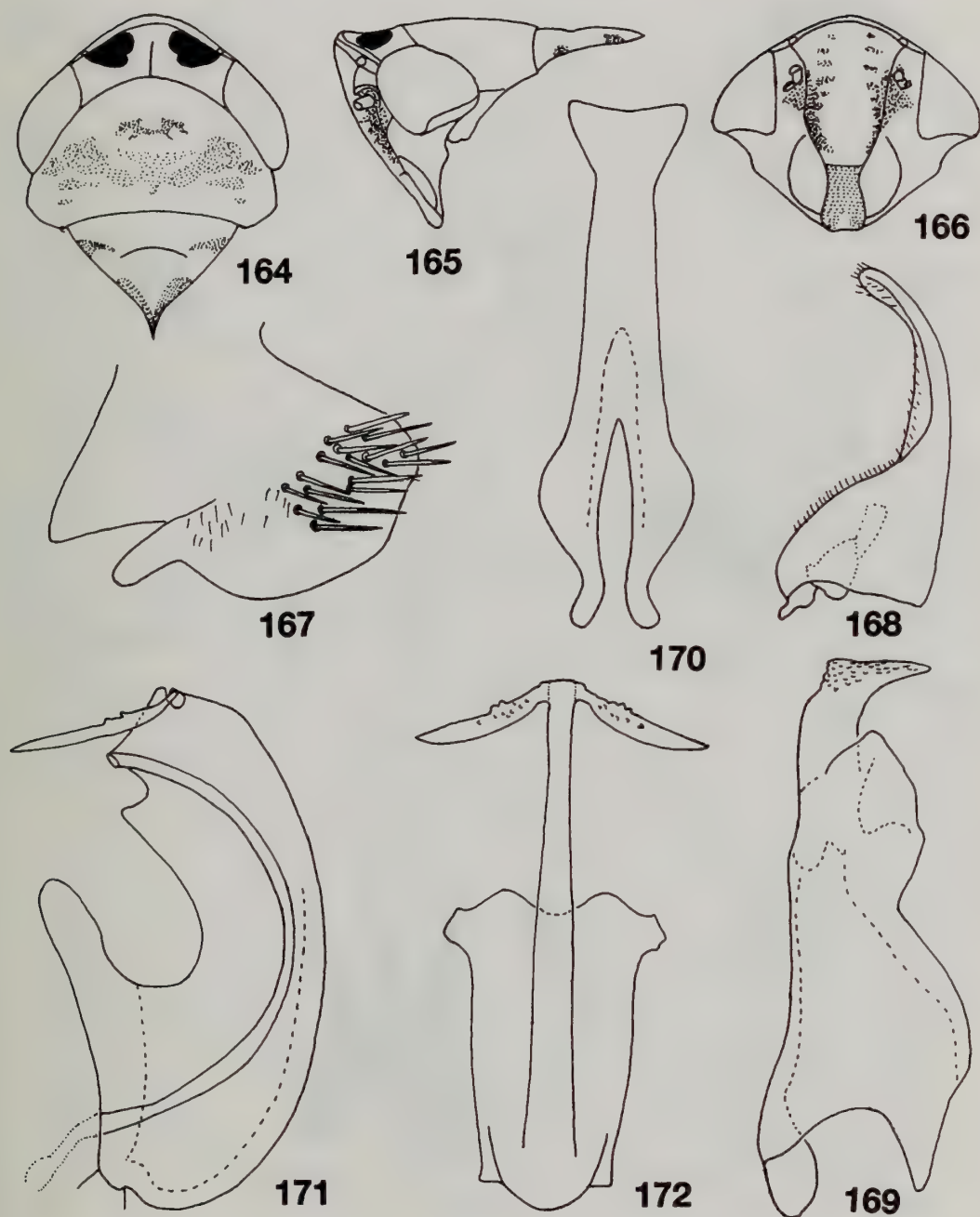


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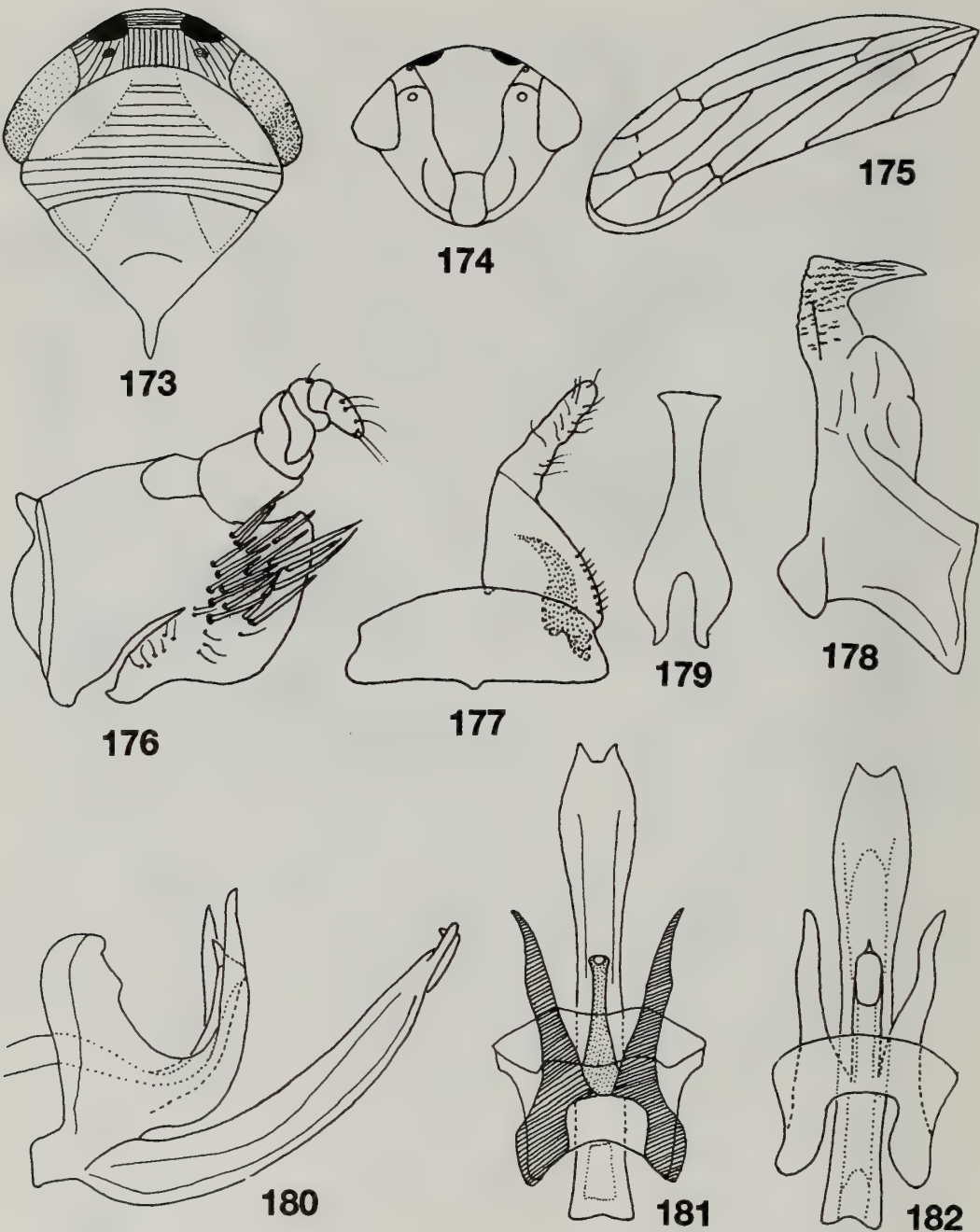




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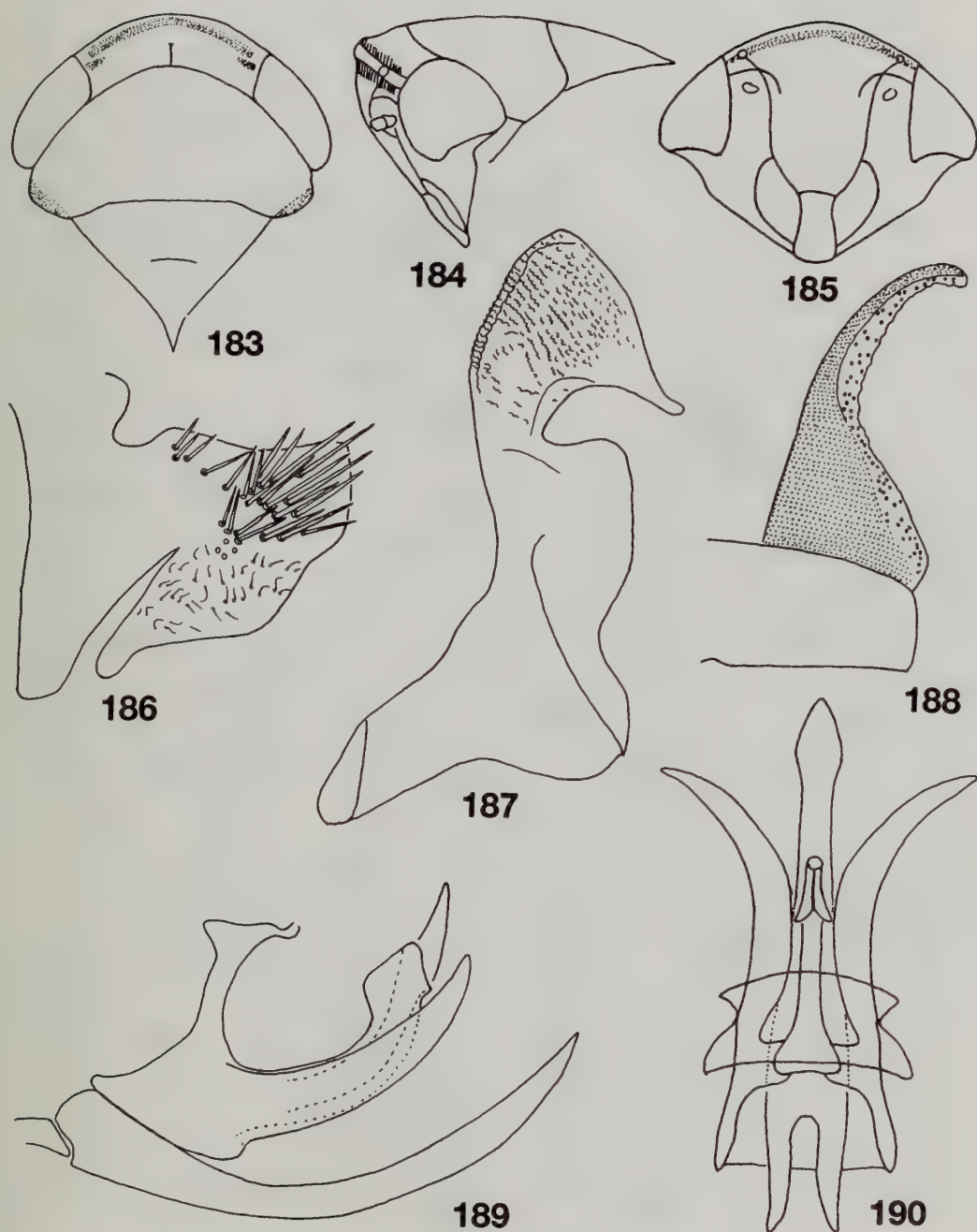


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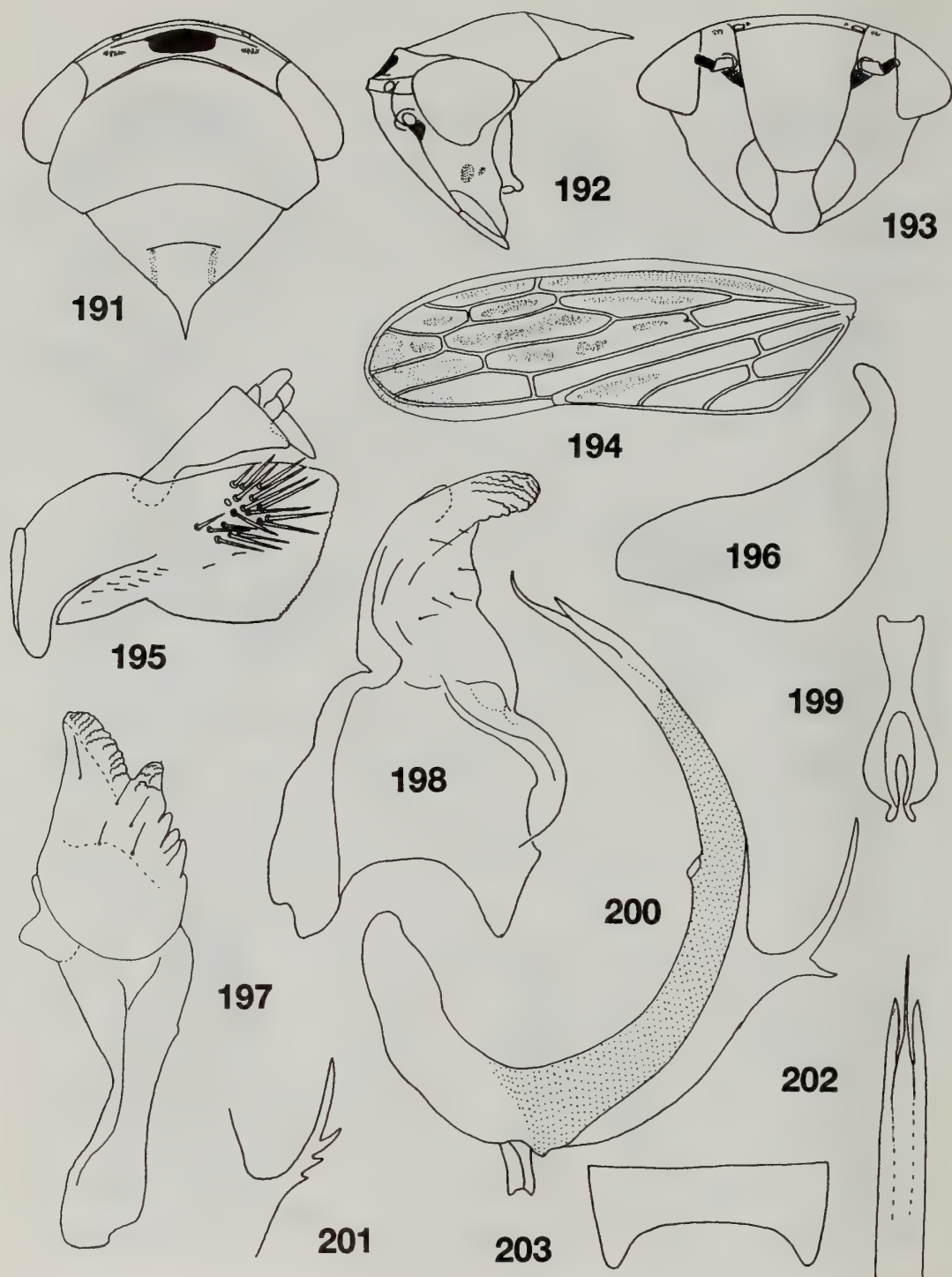


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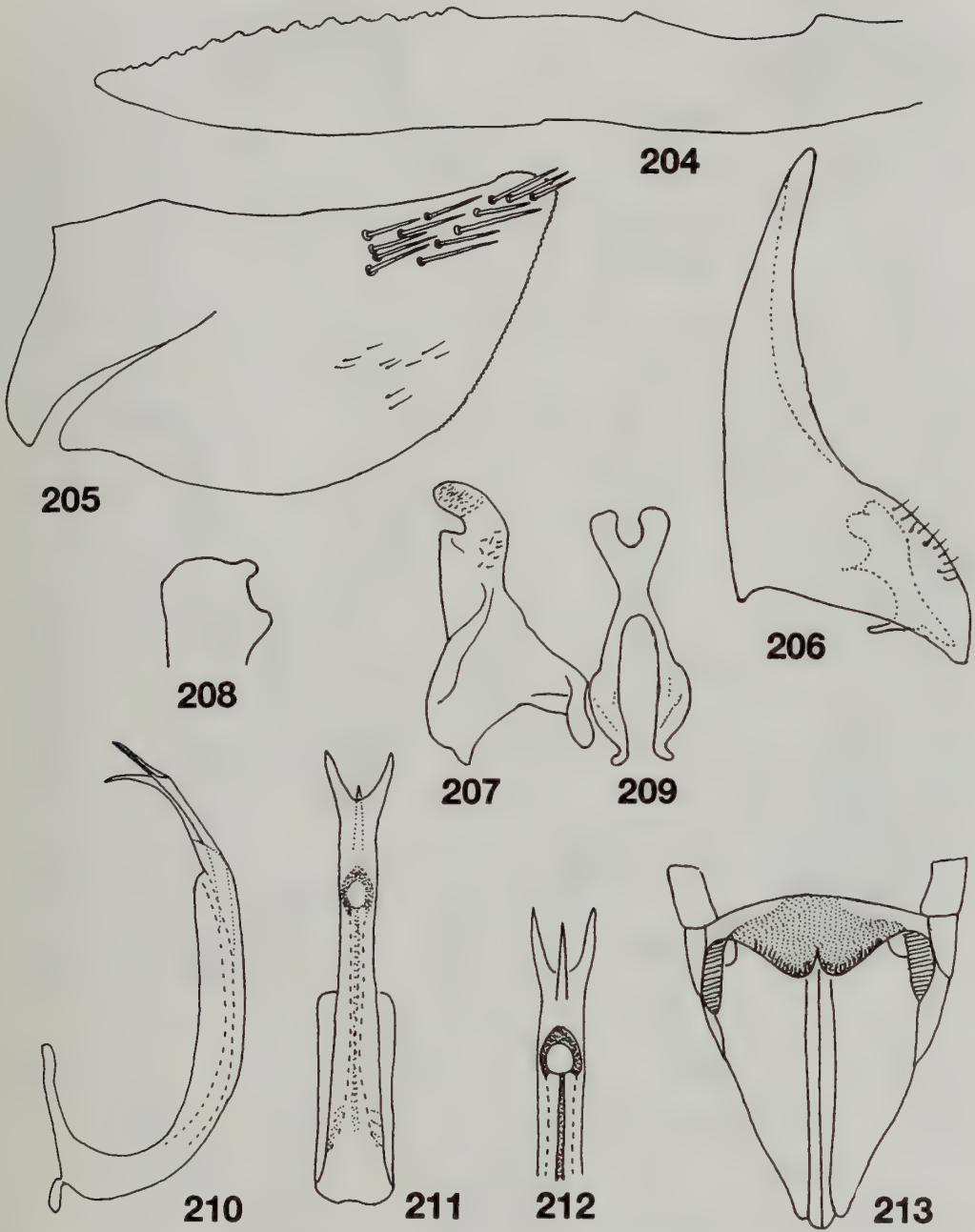




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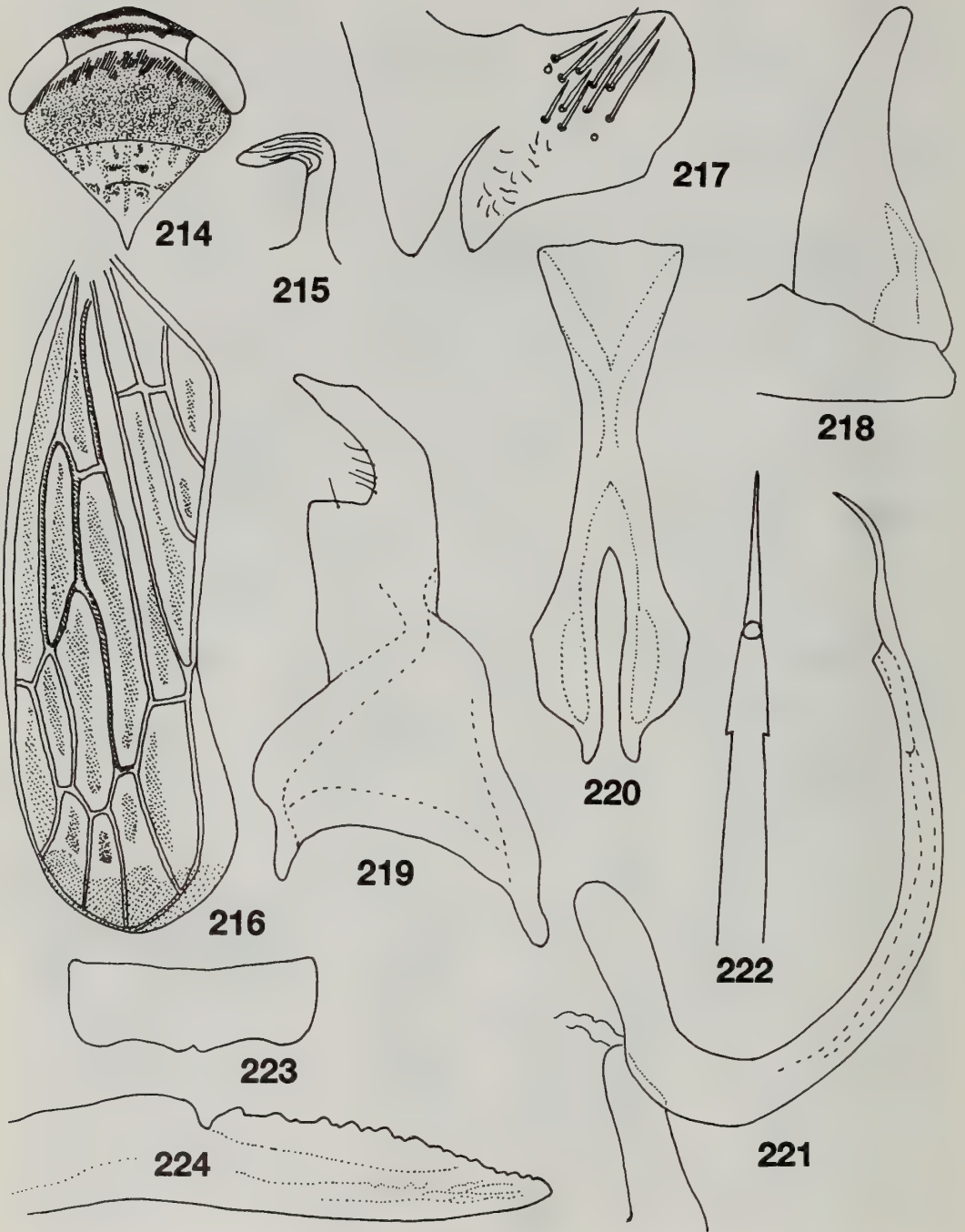


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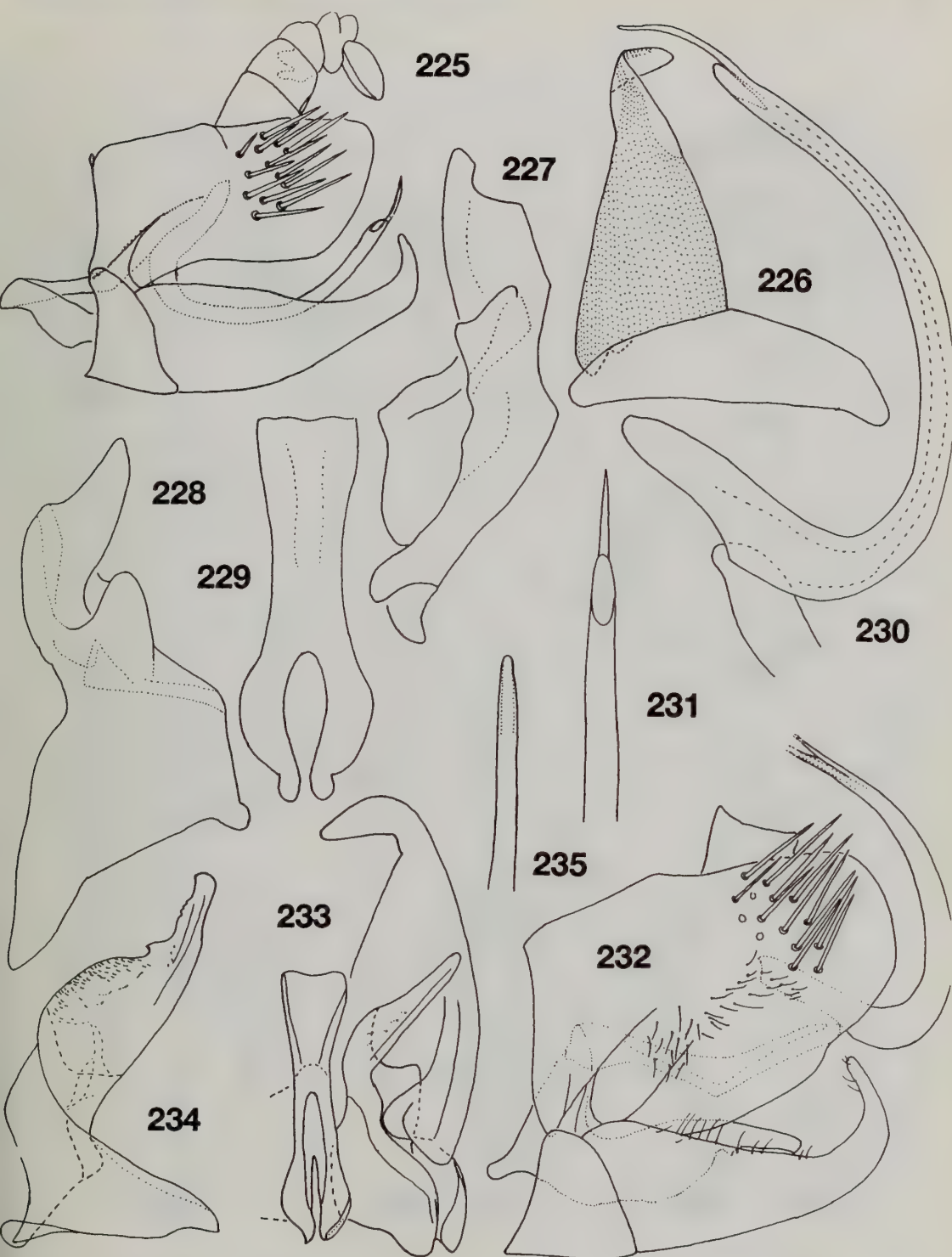


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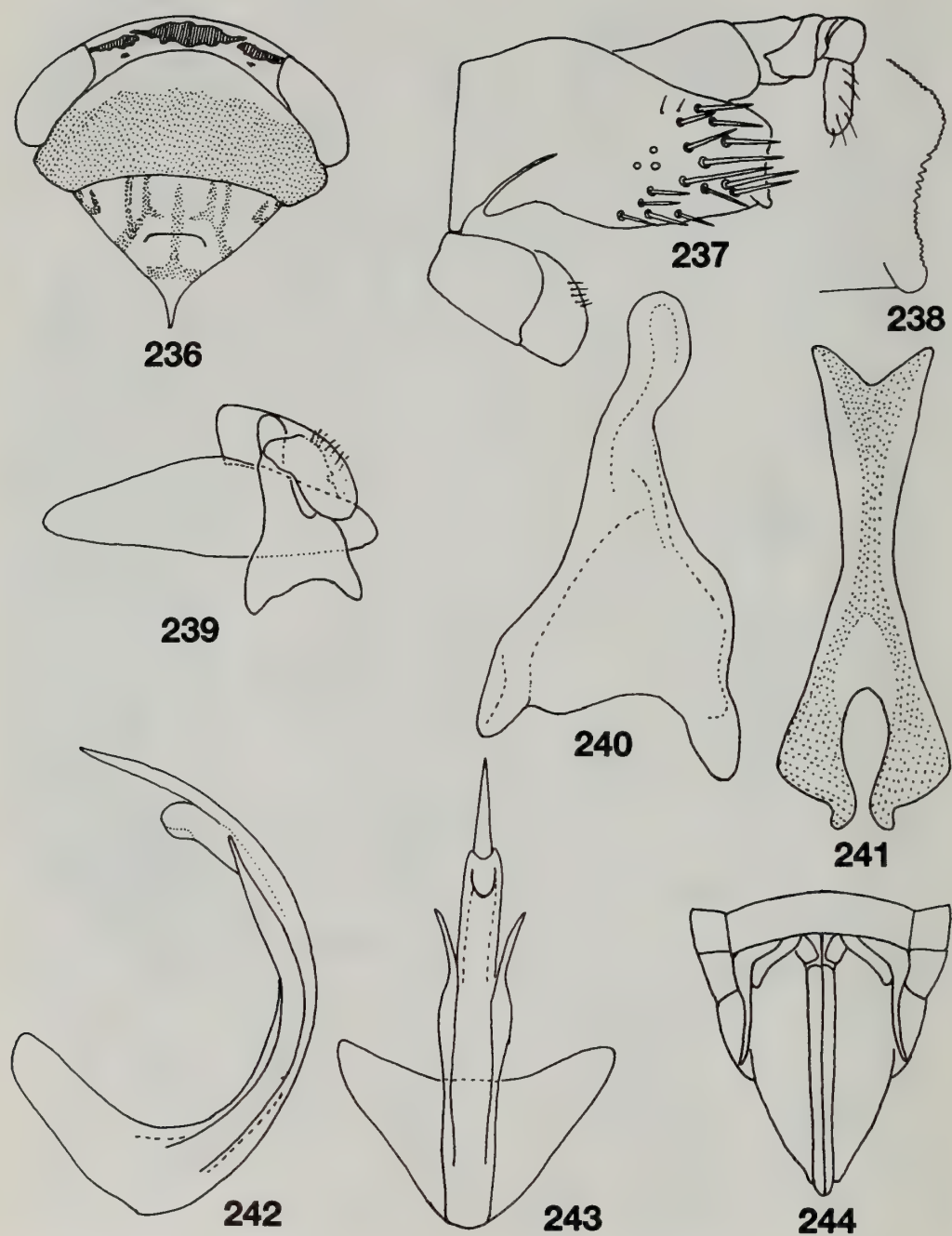




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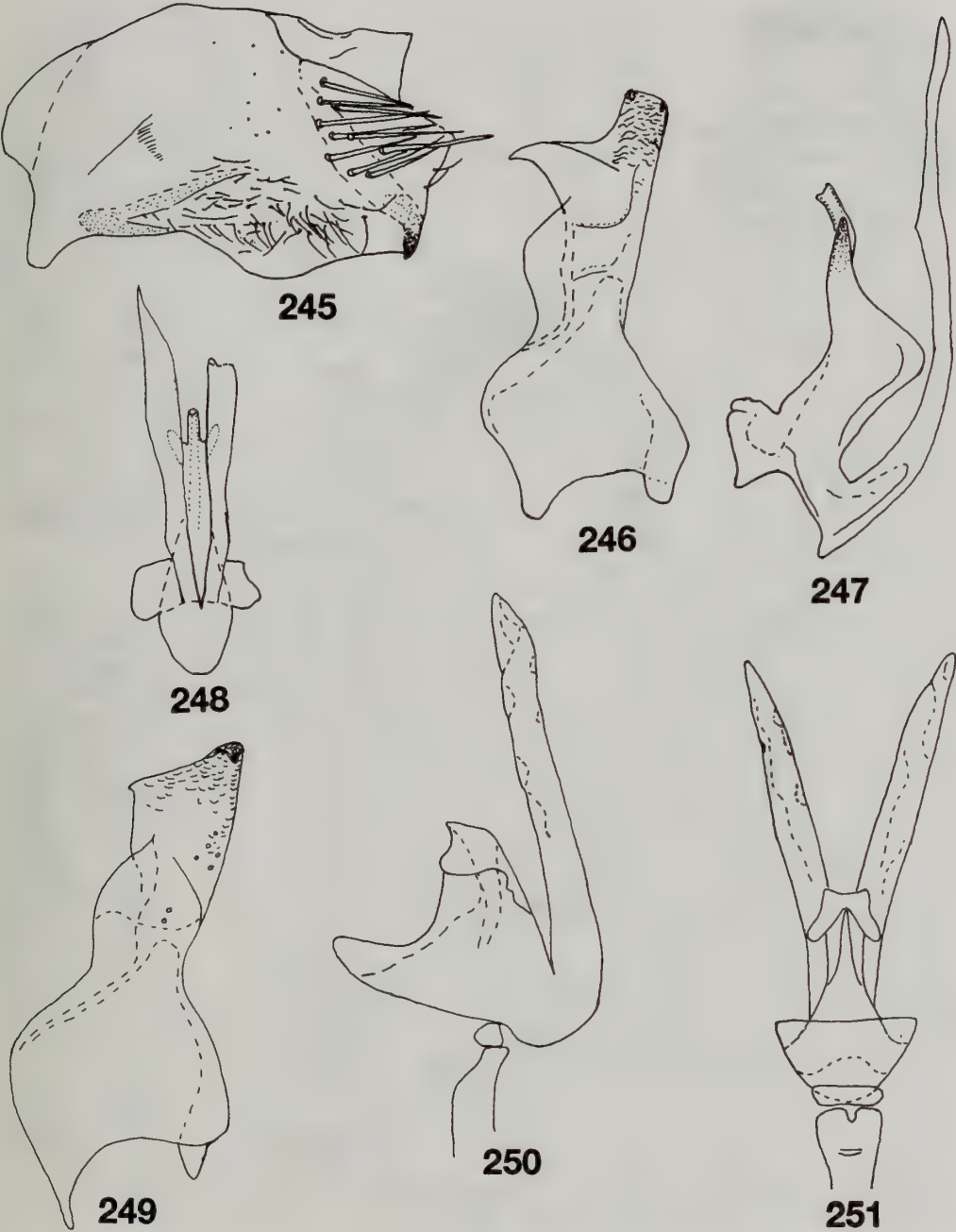


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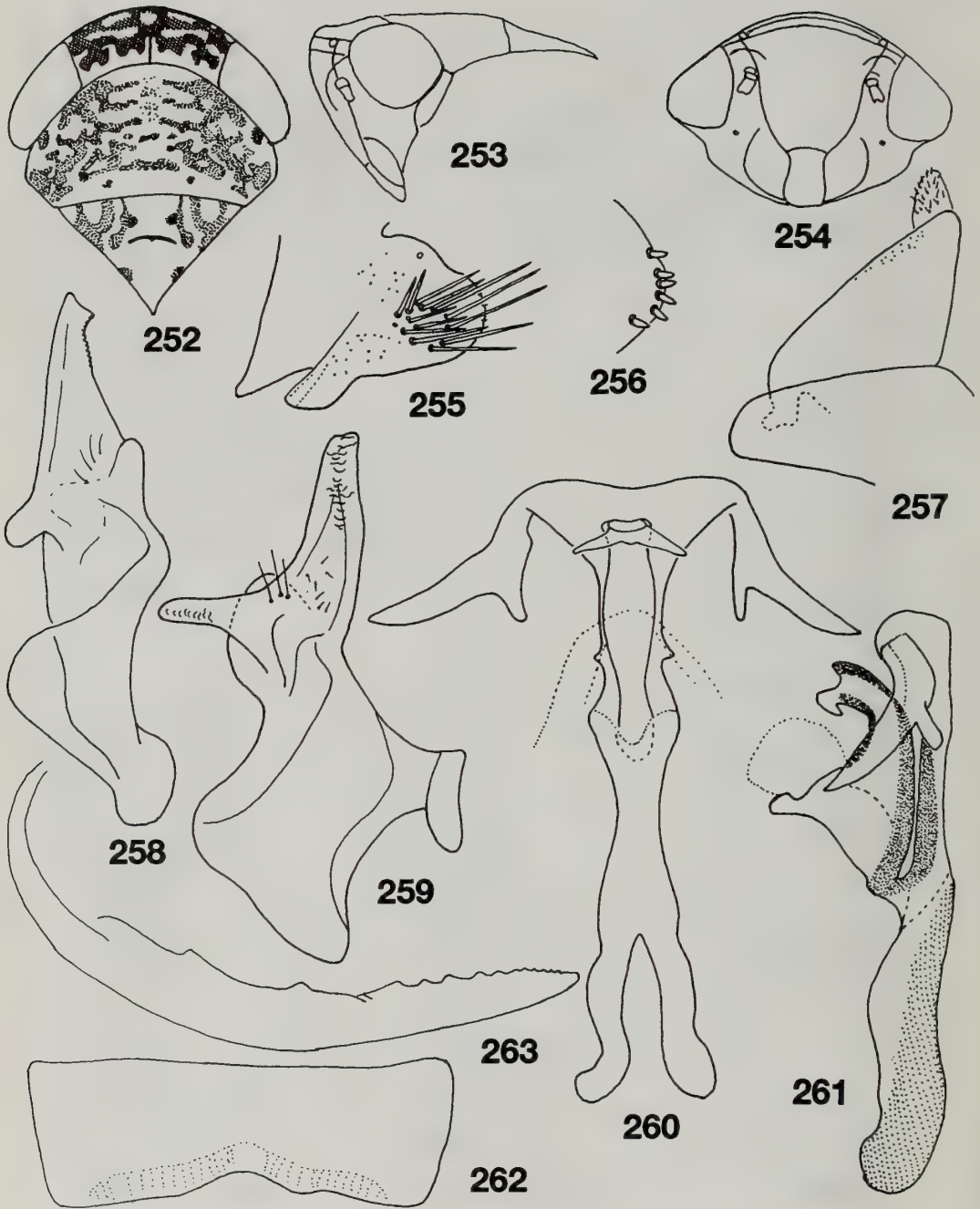


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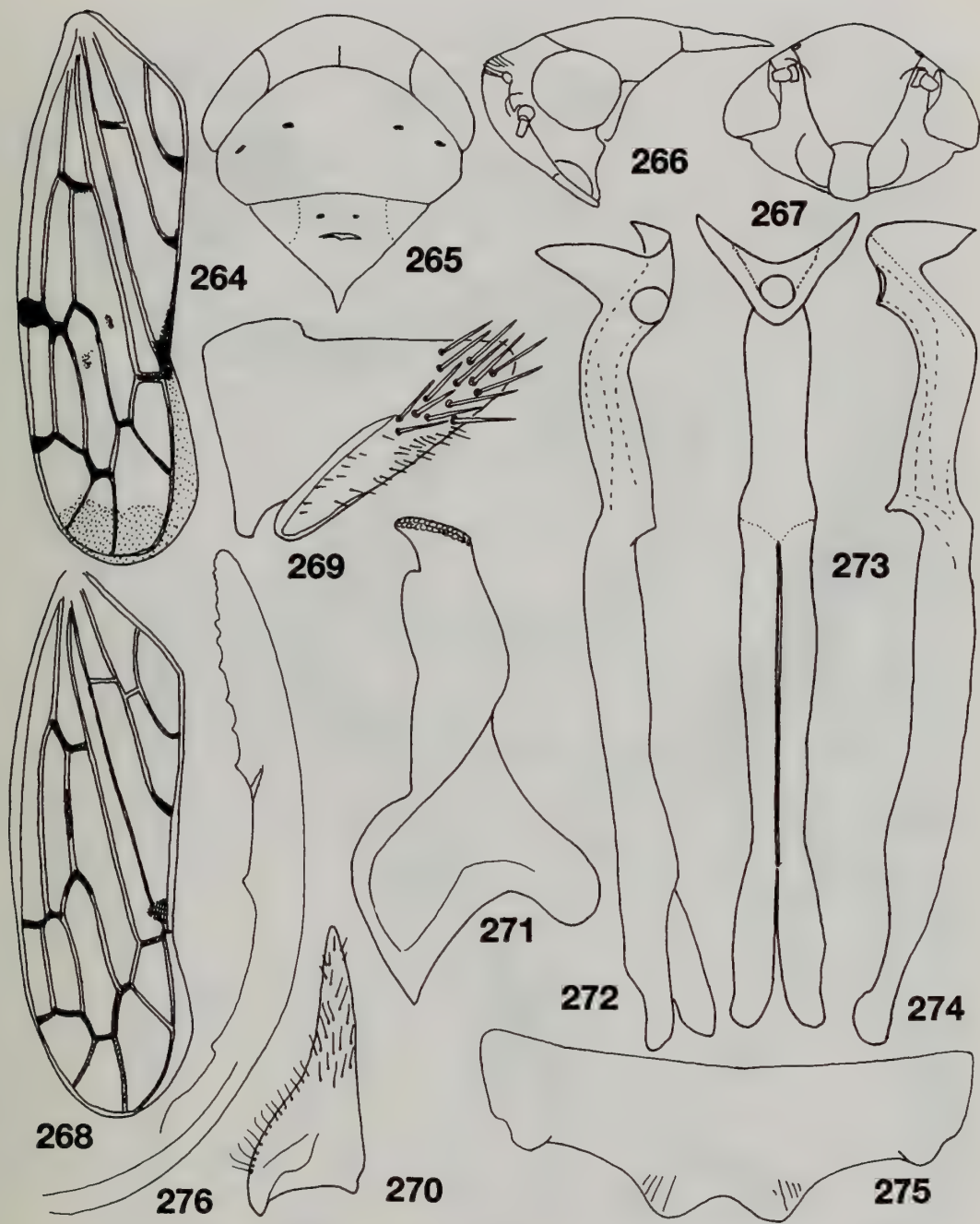




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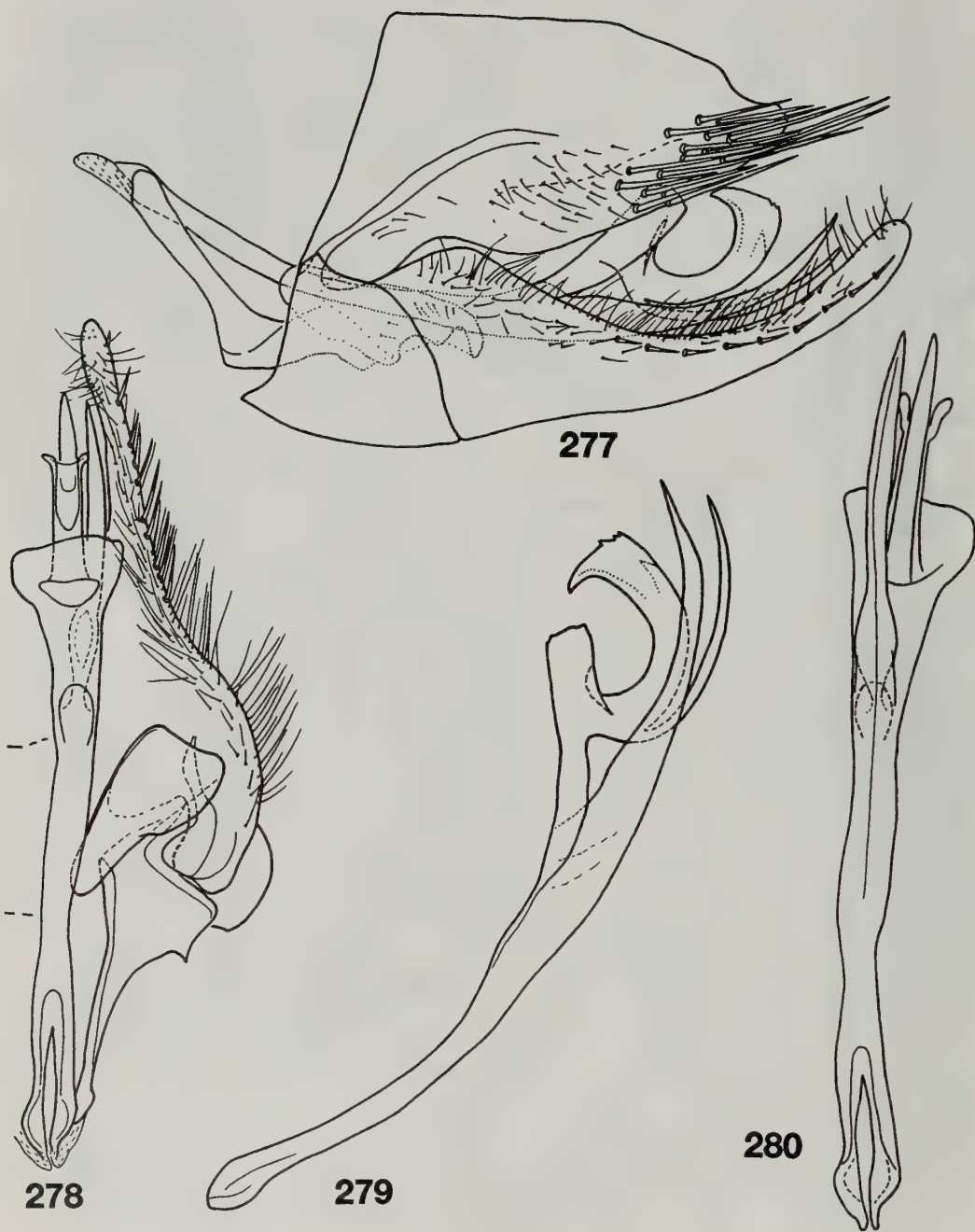


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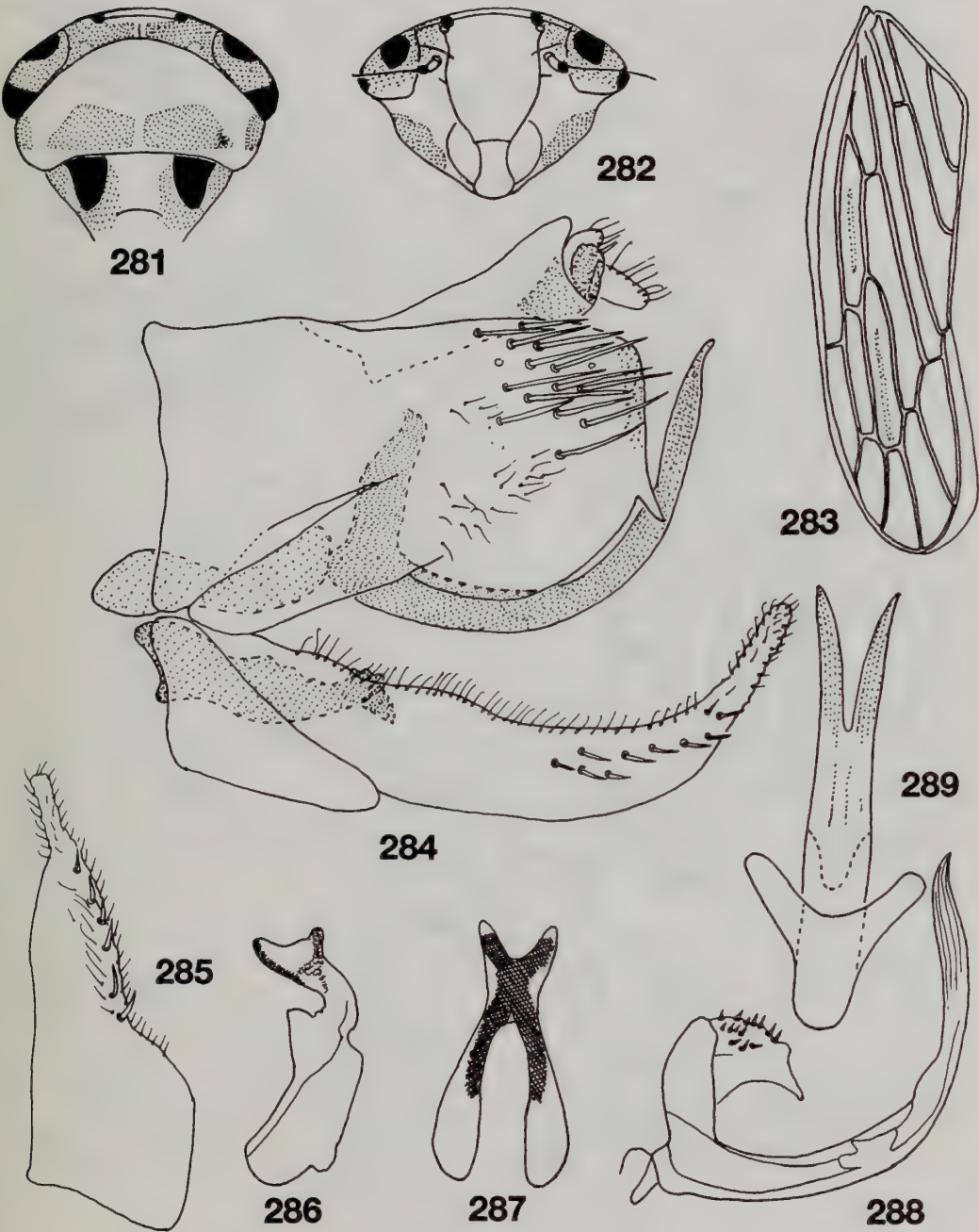


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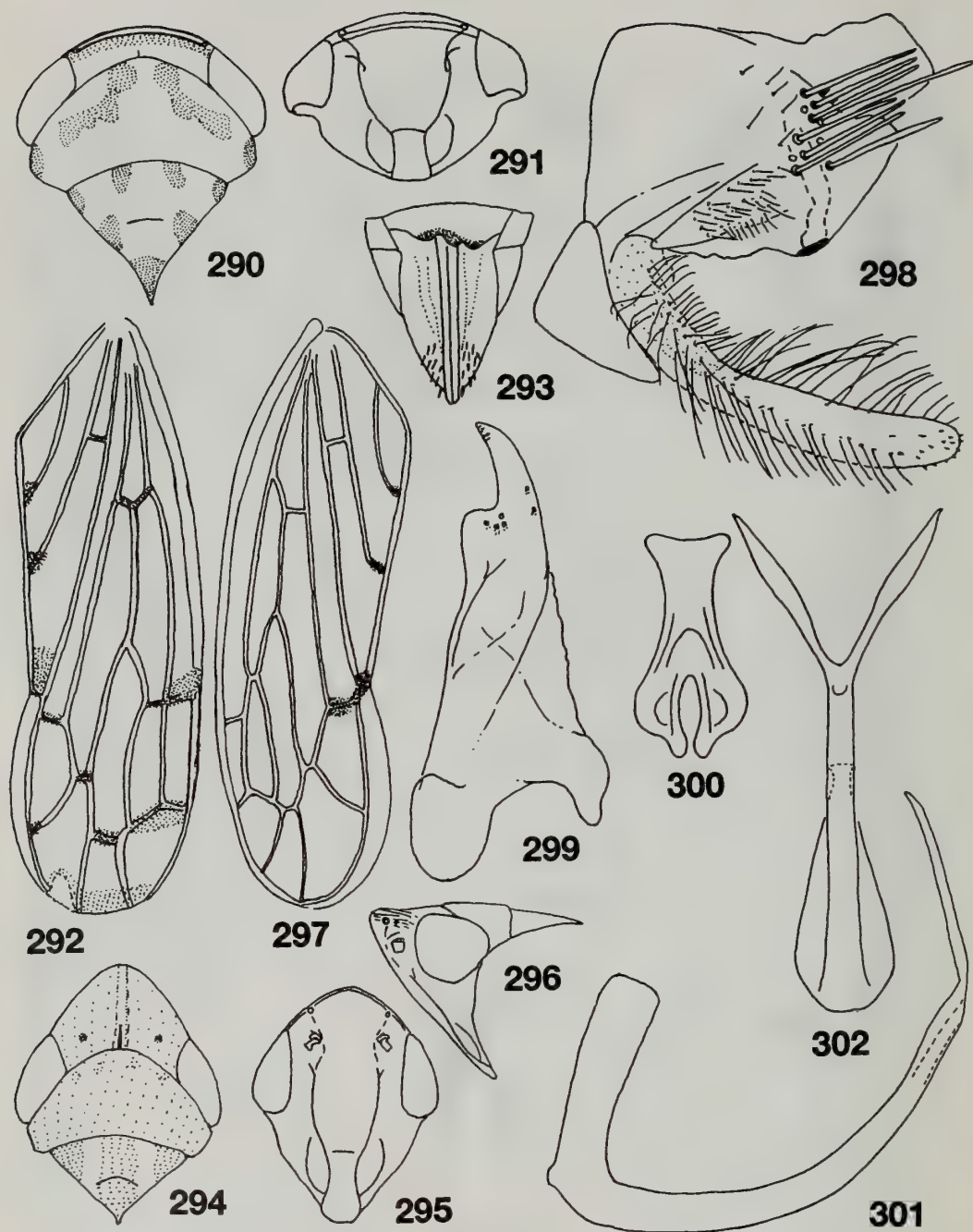




**Figs 277–280.** *Omanella johnsoni*. 277, male genitalia, lateral view; 278, male plate, valve, style, connective and aedeagus, dorsal view; 279, aedeagus and connective, lateral view; 280, same, ventral view (redrawn from Zhang and Webb, 1996).

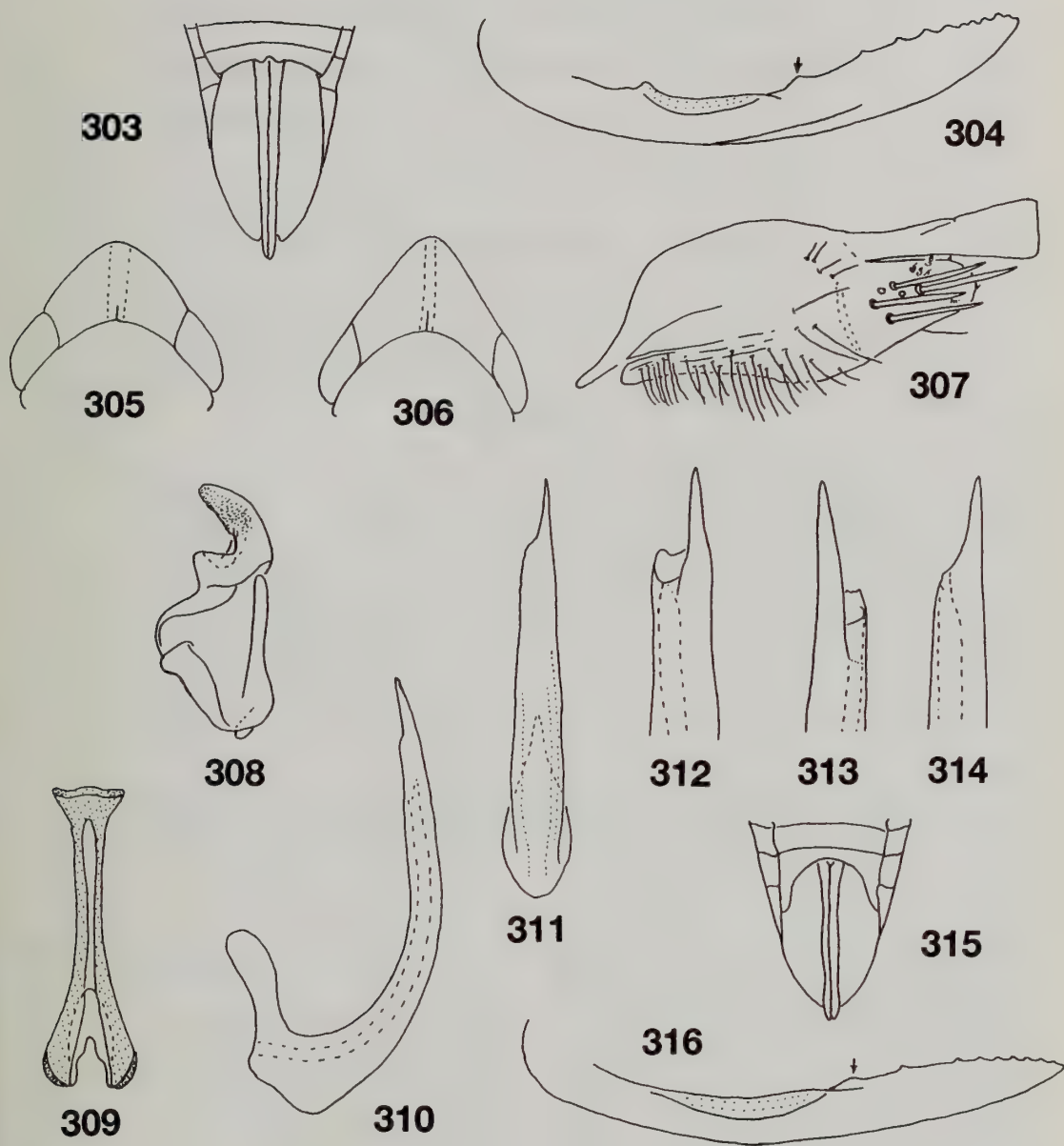


**Figs 281–289.** *Nakula multicolor*. 281, male head and thorax; 282, face; 283, fore wing; 284, male genitalia, lateral view; 285, subgenital plate; 286, style; 287, connective; 288, aedeagus, lateral view; 289, aedeagus, cephalic view.



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**Figs 303–316.** *Dryadomorpha* and *Parohinka* spp. 303–304, *Dryadomorpha pallida*: 303, ovipositor; 304, second pair of valvula. 305–316, *Parohinka longiseta*: 305–306, variation in head; 307, male pygofer and anal tube; 308, style; 309, connective; 310–314, aedeagus, different aspects; 315, female ovipositor; 316, second pair of valvula. (Redrawn from Webb, 1981).



A review of the Palaearctic  
Neorhacodinae (Hymenoptera,  
Ichneumonidae) with *Eremura*  
Kasparyan, 1995 new to the west  
Palaearctic

xx 31255b.1)

DAVID G. NOTTON  
Reading Museum Service, Museum of Reading, Blagrove Street, Reading, RG1 1QH, UK

MARK R. SHAW  
Department of Geology and Zoology, National Museums of Scotland, Chambers  
Street, Edinburgh, EH1 1JF, UK

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**SYNOPSIS.** A review of Palaearctic Neorhacodinae is given including an outline of the characters of the subfamily, a key to all species and descriptions of all genera and species. *Eremura* is recorded as new to the west Palaearctic region.

INTRODUCTION

Neorhacodinae is a small subfamily of inconspicuous ichneumonid wasp parasitoids comprising two distinct but uncommon genera in the Palaearctic; that is, *Neorhacodes* with one species well known in western Europe as a parasitoid of *Spilomena* spp. (Sphecidae) nesting in stems (e.g. Horstmann, 1968; Danks, 1971), and *Eremura* with two species previously known only from the deserts of Turkmenistan (Kasparyan, 1995) whose biology remains unknown. Neorhacodines may be distinguished from other ichneumonids in the Palaearctic region by the combination of the following characters: fore wing with veins Rs and M fused over a short distance so that there are no rs-m cross veins

(Figs 1, 3, 4); fore wing lacking vein Cu2 (Fig. 1); insertion of metasoma low on propodeum so that the lower edge of its foramen is well below the upper edge of the foramina of the coxal insertions; antenna short, at most fifteen-segmented; spiracles of metasomal tergite anterior to mid-length (Figs 10, 16); fore wing vein 2m-cu absent to nebulous, not tubular (Fig. 1). Rarely other ichneumonids may be found with Rs and M fused, that is, Paxylommatinae and a few Anomaloniinae, Cryptinae and Xoridinae, but then the fore wing venation is quite different in other respects and they differ from neorhacodines in at least one of the other characters given above.

A review of Palaearctic neorhacodines is given including an outline of the characters of the subfamily, and a key to all species. Following the examination of



material kindly supplied by J. Blasco-Zumeta, *Eremura* is recorded here as new from Spain and the west Palaearctic. The Spanish material is assigned to *E. perepetshaenkoi*: this species is notable because of its apparent widely disjunct distribution (Spain and Turkmenistan) and its association with desert and semi-desert habitats, which are unusual in a European context. The previously unknown male of *E. perepetshaenkoi* is recognised. *Neorhacodes enslini* is recorded as new to Austria and France.

Nomenclature of wing venation follows Gauld and Bolton (1988). Wing veins were drawn following the convention of Mason (1986).

## DEPOSITORIES

BMNH	The Natural History Museum, London, United Kingdom (formerly the British Museum (Natural History)).
REDMG	Reading Museum Service, Reading, United Kingdom.
NM	Naturhistorisches Museum, Wien, Burgring 7, Postfach 417, 1014 Wien, Austria.
NMS	National Museums of Scotland, Edinburgh, United Kingdom.
ZMAS	Zoological Museum, Academy of Science, St. Petersburg, Russia.

**ACKNOWLEDGEMENTS.** We are most grateful to Javier Blasco-Zumeta for donating to the National Museums of Scotland Hymenoptera roughly sorted to Braconidae, from which the Spanish material of *Eremura* was recovered, from his extensive sampling programme at Los Monegros; to Dimitri Kasparyan of the Zoological Institute, Russian Academy of Sciences, St. Petersburg, for loaning types of *Eremura*; to Mike Fitton and Donald Quicke (Natural History Museum, London) for support from Natural Environment Research Council grant number GR3/8060 for initial studies of sub-family characters of neorhacodines; to Mike Fitton (Natural History Museum, London) for subsequent access to collections and use of facilities; to the staff of the Entomology Library of the Natural History Museum, London.

## NEORHACODINAE HEDICKE

Rhacodinae Ruschka, 1922: 38. [Invalid proposal based on *Rhacodes* Ruschka, junior homonym of *Rhacodes* Koch].

Neorhacodinae Hedicke, 1922: 427. Type-genus: *Neorhacodes* Hedicke.

**DESCRIPTION.** Head (Figs 5, 11) lenticular; inner orbits nearly parallel; face with a small tubercle between toruli; clypeus relatively large, projecting

ventrally so that it partially conceals the mandibles when they are at rest, setation sparse on disc, with an irregular fringe on ventral margin, both discal and marginal setae about twice as long as those on face immediately above; occipital carina complete, joining hypostomal carina distant from base of mandibles. Antenna filiform, thirteen- to fifteen-segmented, with the basal flagellar segments attenuated in females, less so in males; labrum normally concealed; mandibles bidentate, not carinate on external face, twisted so that the longer lower tooth is advanced; maxillary palp four-segmented; labial palp three-segmented. Propleuron without a postero-ventral flange overlapping the lower corner of pronotum; mesoscutum strongly convex anteriorly; sternaulus and mesepisternal sulcus absent; mesopleural furrow finely foveate, not angled opposite scrobe; mesosternum without a posterior transverse carina; propodeal spiracle small and round. Fore wing (Figs 1, 3, 4) extending beyond apex of metasoma, its venation generally abbreviated and condensed; veins Rs and M fused over a short distance so that there are no rs-m cross veins; Cu2 absent; 2m-cu absent, nebulous or spectral but not tubular; hind wing (Fig. 2) with one weak basal hamulus at about level of cu-a and three (rarely four) distal hamuli; abscissa of Cu between M+Cu and cu-a about twice as long as cu-a; distal abscissa of Cu spectral or absent; basal cell with a single specialised seta subapically and a short row basally along anterior margin (these setae are longer and more erect than surrounding setae). Legs with trochantellus clearly marked off from rest of femur by a suture; shaft of fore tibia without differentiated spines; apex of fore tibia without a dentiform process; fore basitarsus 0.65–0.85 length of rest of tarsus; apices of mid and hind tibiae with spurs and tarsus sharing a common insertion; mid and hind tibiae each with two spurs; apex of hind tibia without a differentiated transverse posterior comb; tarsal claws simple. Metasoma (Figs 7, 8, 10, 13, 14, 16) inserted low on propodeum, so that the lower edge of its foramen is well below the upper edge of the foramina of the coxal insertions; metasomal tergite one slightly longer than tergite two (measured at mid-line); tergite two with thyridia near basal margin; tergite three without thyridia; tergite two longer than exposed portion of tergite three (measured at mid-line) and not fused with it; apical tergite not produced; anterior, more sclerotised part of metasomal sternite one very short, extending no more than 0.4 length of tergite one, barely visible between hind coxae; female with fourth to sixth metasomal sternites narrowed medially; dorsal valve of ovipositor with a subapical notch (Figs 9, 15); ventral valves abruptly narrowed subapically, their tips needle-like; ovipositor sheaths parallel

sided in lateral view (Figs 10, 16), flexible, transversely striate over most of length.

COMMENTS. The subfamily comprises three small genera, *Eremura*, *Neorhacodes* and *Romaniella*, the last of which is only known to occur in the Neotropical region and is not considered further here. Despite the superficial dissimilarity of *Eremura* and *Neorhacodes*, we concur with Kasparyan's placement of *Eremura* in Neorhacodinae. Probable synapomorphies for *Eremura* and *Neorhacodes* include: the condensed and abbreviated form of the fore wing venation, in particular the fusion of Rs and M; the form of the clypeus; the form of the mandibles and the small number of antennal segments. Neorhacodines are unusual among ichneumonids in that the number of antennal segments appears fixed for each species. For *Eremura perepetchaenkoi* the number is sexually dimorphic, being fixed at fourteen for females and fifteen for males, while for *E. turkmenica* and *Neorhacodes enslini* it is fixed at thirteen for both sexes (but see notes under *N. enslini*).

Key to Palaearctic species of Neorhacodinae

- 1 Metasomal tergites 1–3 dorsally with granulate sculpture and longitudinal striation, each of these tergites with a transverse impression just behind middle (Figs 7, 8); propodeum dorsally with several carinae (Fig. 6); head and mesosoma with obvious granulate sculpture; apex of metasoma dorsoventrally depressed (Figs 8, 10); dorsum of metasomal tergite 1 with basal area delimited by a pair of curved carina (Fig. 7) ..... *Neorhacodes enslini*
- Metasomal tergites 1–3 dorsally smooth and without transverse impressions (Figs 13, 14); propodeum dorsally without carinae (Fig. 12); head and mesosoma mostly smooth, sculpture no more than fine puncturation in part; apex of metasoma laterally compressed (Figs 14, 16); dorsum of metasomal tergite 1 with basal area not delimited (Fig. 13) ..... 2
- 2 Fore wing with radial cell shorter, 2.3–2.8× as long as wide (Fig. 3); vein Rs tubular, at least weakly pigmented, usually straight over basal 0.65 then turning towards costa (Fig. 3), sometimes weakly sinuate; metapleural carina complete, fine but distinct; antenna 14–(♀) or 15-segmented (♂), with the third segment 2.7× as long as its greatest width; toruli distant from compound eyes by 0.8–0.9× greatest internal torular diameter (Fig. 11); pterostigma mostly brown, pale in basal third (Fig. 3) *Eremura perepetchaenkoi*
- Fore wing with radial cell longer, 3.5–3.7× as long as wide (Fig. 4); vein Rs nebulous to spectral, unpigmented and distinctly sinuate (Fig. 4); metapleural carina obsolete anteriorly, the metapleuron delimited anteriorly by a weak depression; antenna 13-segmented, with the third segment almost 5× as long as its greatest width; toruli distant from compound eyes by 1.2× greatest internal

torular diameter (Fig. 17); pterostigma pale yellow with brown margins (Fig. 4) ..... *Eremura turkmenica*

EREMURA Kasparyan

*Eremura* Kasparyan, 1995: 669. Type-species: *Eremura turkmenica* Kasparyan, by original designation.

DESCRIPTION. Ventral margin of clypeus rounded in frontal view (Fig. 11). Pronotum without epomia or striae; notauli absent; lateral mesoscutal carina not extending posteriorly to scutellum but turning laterally across axillary trough; epicnemial carina extending dorsally only a short distance, turning to join anterior margin of mesopleuron at about level of lower corner of pronotum; dorsal area of metanotum with at most a weak antero-medial fovea, posteriorly convex; propodeum dorsally without carinae (Fig. 12) and with the postero-medial area (just in front of the metasomal insertion) raised so that the dorsal profile is weakly convex. Hind wing with three distal hamuli. Metasomal tergite one without a glymma, with a dorsolateral carina parallel with and close to the lateral margin, delimiting a narrow lateral area in front of the spiracle, this area about 3.5–4.0× as long as wide (Fig. 16); spiracle of tergite one close to its lateral margin and just in front of mid-length (Fig. 16); dorsum of tergite one with a basal area not delimited (Fig. 13); metasoma beyond tergite one weakly sclerotised, tending to collapse and distort on drying, particularly when specimens have been extracted from fluid preservatives, that of the female laterally compressed apically (Figs 14, 16), less compressed in the male; laterotergites of tergite two moderately broad, about half as wide as long, though weakly sclerotised and difficult to see if folded behind tergite (as in Fig. 16), the fold line indicated by band of weak sclerotisation just below level of spiracle and extending 0.6–0.7 length of tergite; tergites three and beyond without such fold lines; female with spiracle on tergite seven subequal to that on tergite six; second and third sternites with weakly sclerotised region medially (Fig. 16); ovipositor extending beyond apex of metasoma by about 0.9 length of hind tibia; ovipositor strongly compressed laterally (Fig. 14) and weakly curved upwards (Fig. 16), although weakly sclerotised and may become strongly curved and twisted in specimens which have been collected in fluid and then dried. Body mostly smooth and shining but weakly scabrous on the lateral propodeum around the spiracle; metasomal tergites without transverse impressions (Figs 13, 14); sclerotised parts of second and third sternites smooth; legs smooth. Body with moderately dense to sparse, fine, short pubescence except the clypeus, which has long setae (Fig. 11), and bare areas dorsally on metasomal tergites two to four (Fig. 14), postero-medially on the propodeum (Fig. 12) and the postero-dorsal half of the mesopleuron.



COMMENTS. This genus has been recorded from Turkmenistan and is recorded as new for Spain. Kasparyan (1995) gave a habitus figure of *E. perepetshaenkoi* which is representative of the genus. Host relations unknown, although there appears to be an association with desert and semi-desert habitats and the laterally compressed metasoma and ovipositor suggest that concealed hosts are attacked.

### *Eremura perepetshaenkoi* Kasparyan

(Figs 3, 11–16)

*Eremura perepetshaenkoi* Kasparyan, 1995: 672.

Holotype ♀, **Turkmenistan** (ZMAS) (examined).

DESCRIPTION. Ocellar-ocular distance  $0.55\text{--}0.65\times$  distance between posterior ocelli; toruli separated by  $1.0\text{--}1.1\times$  greatest internal torular diameter (Fig. 11); toruli distant from compound eyes by  $0.8\text{--}0.9\times$  greatest internal torular diameter; malar space  $0.30\text{--}0.35\times$  (♀) or  $0.40\text{--}0.45\times$  (♂) basal width of mandible; malar sulcus indistinct to absent; antenna fourteen- (♀) or fifteen-segmented (♂), with the third segment  $2.6\text{--}2.7\times$  (♀) or  $2.2\text{--}2.3\times$  (♂) as long as its greatest width and  $1.2\text{--}1.3\times$  (♀) or  $1.1\times$  (♂) as long as the fourth. Mesoscutum with fine, close puncturation; metapleural carina complete, fine but distinct. Fore wing with radial cell  $2.3\text{--}2.8\times$  as long as wide (Fig. 3); vein Rs tubular, at least weakly pigmented, usually straight over basal  $0.65$  then turning towards costa, sometimes Rs weakly sinuate; 2m-cu absent. Metasomal tergite two with thyridia present but poorly defined (Fig. 14, 16); dorsal valve of ovipositor with subapical notch about three times as long as deep (Fig. 15). Head and mesosoma dark brown to black; metasoma brown to dark brown; antenna dark brown; mandibles dark brown to black with tips red-brown; pterostigma mostly dark brown, but with pale area in basal third (Fig. 3); legs brown except fore and mid tibiae and tarsi which are often yellow-brown, and apices of fore and mid femora and sometimes also bases and apices of tibiae which are yellow to yellow-brown. Body length  $1.3\text{--}2.0$  mm (♀) or  $1.6\text{--}1.7$  mm (♂); fore wing length  $1.3\text{--}2.1$  mm (♀) or  $1.6\text{--}1.7$  mm (♂).

#### MATERIAL EXAMINED.

Holotype. **Turkmenistan**: ♀, Kopet-Dag, Karael'chi range, near Parkhai, 25.v.1993 (*Perepechaenko*) (ZMAS).

**Turkmenistan**: ♀, Akarcheshme Badkhyzskii, zapk raznotr, 2.v.1990 (*Belokobyl'skii*). **Spain**: 15 ♀, ♂ Zaragoza province, Los Monegros, Retuerta de Pina, 30T YL2794, Moericke/Malaise traps, 7–24.v.1991 (*Blasco-Zumeta*) (BMNH; NMS; ZMAS).

COMMENTS. A habitus figure was given by

Kasparyan (1995). The discovery of *E. perepetshaenkoi* in the Monegros region of the central Ebro valley, east of Zaragoza in northern Spain, is not particularly surprising in view of the large and growing number of taxa from the region found to have disjunct distributions such that they are otherwise known only from the steppes of the eastern Mediterranean or central Asia (Ribera and Blasco-Zumeta, in press). The particular area in which the Spanish specimens were collected is a relatively small undamaged fragment (circa 2000 ha) of forest steppe (with *Juniperus thurifera* and *Pinus halepensis*) surviving near Pina de Ebro known as 'Retuerta de Pina' (UTM grid square 30T YL2794). It is characterised by its climate (Ochoa, 1982) of extreme temperatures, desiccating winds and low rainfall, as well as gypsum soils (Quirantes, 1978), which together lead to a characteristic and species deficient vegetation (Braun-Blanquet and Bolós, 1957). The Monegros area, which is under serious threat of irrigation, is of great scientific significance and is known to support a large number of endemic species of insects and other organisms, of which over 100 have already been described following a recent intensive survey (Blasco-Zumeta, 1996 and pers. comm.).

### *Eremura turcmenica* Kasparyan

(Figs 4, 17)

*Eremura turcmenica* Kasparyan, 1995: 671. Holotype ♀, **Turkmenistan** (ZMAS).

DESCRIPTION (female only). Ocellar-ocular distance  $0.65\times$  distance between posterior ocelli; toruli separated by  $0.75\times$  greatest internal torular diameter; toruli distant from compound eyes by  $1.2\times$  greatest internal torular diameter (Fig. 17); malar space  $0.5\times$  basal width of mandible; malar sulcus fine but distinct; antenna thirteen-segmented, with the third segment  $4.7\times$  as long as its greatest width and  $1.7\times$  as long as the fourth. Mesoscutum smooth and shining, impunctate; metapleural carina obsolete anteriorly, the metapleuron delimited there by a weak depression. Fore wing with radial cell  $3.5\text{--}3.7\times$  as long as wide (Fig. 4); vein Rs nebulous, becoming spectral near apex, unpigmented and distinctly sinuate; 2m-cu nebulous/spectral, unpigmented. Metasomal tergite two with thyridia distinct, transverse. Head and mesosoma dark brown to black; metasoma brown to dark brown; antenna dark brown; mandibles dark brown to black with tips red-brown; pterostigma mostly yellow, finely edged brown (Fig. 4); legs brown except for tarsi, tibiae and apices of femora which are yellow-brown. Body length 1.7 mm; fore wing length 1.7 mm.



## MATERIAL EXAMINED.

**Turkmenistan:** ♀, Kopet-Dag, Karael'chi range, near Parkhai, 25.v.1993 (*Perepechaenko*) (ZMAS) (paratype).

**COMMENTS.** Male not seen; according to Kasparyan it is similar to the female but slightly larger and there are small differences in the proportions of its antennal segments.

**NEORHACODES Hedicke**

*Rhacodes* Ruschka, 1922: 138. Type-species: *Rhacodes enslini* Ruschka by original designation and monotypy. [Junior homonym of *Rhacodes* Koch, 1856].

*Neorhacodes* Hedicke, 1922: 427. [Replacement name for *Rhacodes* Ruschka].

**DESCRIPTION.** Ventral margin of clypeus almost straight in frontal view (Fig. 5). Pronotum without a distinct epomia but with several striae crossing lateral furrow; notauli weakly impressed anteriorly and each with a short carina along inner margin; lateral mesoscutal carina extending posteriorly to scutellum; epicnemial carina extending dorsally 0.4–0.5× height of mesopleuron, ending distant from its anterior margin; dorsal area of metanotum with strong antero-medial fovea, posteriorly bordered by a transverse carina; propodeum dorsally with submedial and lateral longitudinal carinae (Fig. 6) and a posterior transverse carina, its dorsal profile angled at line of posterior transverse carina. Hind wing with three or four distal hamuli (Fig. 2). Metasomal tergite one with a deep basal glymma, with a dorso-lateral carina parallel with and close to lateral margin, delimiting a narrow lateral area in front of the spiracle, this area 2.1–2.8× as long as wide (Fig. 10); spiracle of tergite one distant from its lateral margin and well in front of its mid-length (Fig. 10); dorsum of tergite one with basal area delimited by a pair of curved carinae (Fig. 7); tergites one to five strongly sclerotised, not collapsing on drying, the other tergites less sclerotised, retracted and not visible from above; apex of metasoma dorso-ventrally depressed (Figs 8, 10); laterotergites two and three delimited by a sharp crease, very narrow and folded behind rest of tergite; female with second and third sternites coriaceous and evenly sclerotised medially; ovipositor straight (Fig. 10), not strongly compressed laterally but evenly tapered when seen from above (Fig. 8), extending beyond apex of metasoma by about 0.7 length of hind tibia. Most of body with granular sculpture except for pronotum which has fine striae, and axillae, metanotum and propodeum which are more or less smooth with obscure sculpture; metasomal tergites one to three dorsally with granulate sculpture and longitudi-

nal striation, each of these tergites with a transverse impression just behind the middle (Figs 7, 8); tergite four similar but with transverse impression very weak; tergite five smooth and shining; legs smooth except for mid and hind coxae and hind femur which have granulate to coriaceous sculpture. Most of body with more or less sparse, fine, short pubescence except the mesonotum which has dense pubescence and the posterior pronotum, postero-dorsal mesopleuron, metapleuron and posterior propodeum which are bare.

**COMMENTS.** Townes (1970) gave a habitus figure which is representative of the genus. One species, *N. enslini*, has been recorded from the Palaearctic and several others are known from the Nearctic (Cushman, 1940; Townes, 1970) and the Neotropical (Townes, 1970) regions.

***Neorhacodes enslini* (Ruschka)**

(Figs 1, 2, 5–10)

*Rhacodes enslini* Ruschka, 1922: 138. Holotype ♀, Germany (NM).

*Neorhacodes enslini* (Ruschka); Hedicke, 1922: 427.

**DESCRIPTION.** Ocellar-ocular distance 0.60–0.70× distance between posterior ocelli; toruli separated by 1.5–1.8× greatest internal torular diameter; toruli distant from compound eyes by 0.6× greatest internal torular diameter; malar space 0.35–0.40× (♀) or 0.40–0.55× (♂) basal width of mandible; malar sulcus absent; antenna thirteen-segmented, with the third segment 3.5–4.0× (♀) or 3.4–3.7× (♂) as long as its greatest width and 1.5–1.6× as long as the fourth. Metapleural carina fine, varying from distinct and complete to only weakly indicated. Fore wing with radial cell 2.4–2.7× as long as wide (Fig. 1); vein Rs nebulous, not pigmented and weakly sinuate; 2m-cu spectral, unpigmented. Metasomal tergite two with thyridia distinct, transverse (Fig. 8); dorsal valve of ovipositor with subapical notch about 1.5× as long as deep (Fig. 9). Body black; antenna dark brown to black, base of flagellum, scape and pedicel often partly reddish or yellowish in female; clypeus sometimes reddish brown apically; mandibles rather variable in colour, black to reddish-brown; pterostigma mostly dark brown but with pale area in basal third (Fig. 1); legs dark brown to black but with femoral apices, front and mid tibiae and tarsi yellow to yellow-brown and hind tibia basally yellow-brown. Body length 2.3–2.5 mm (♀) or 2.2–2.6 mm (♂); fore wing length 2.0–2.3 mm (♀) or 2.0–2.2 mm (♂).

## MATERIAL EXAMINED.

**Austria:** 2 ♀, Spitzzicken Bgld., 5.viii.1957 (*Fischer*) (BMNH). **Cyprus:** ♂, Ayia Mavi, Krios R., 7.ix.1937 (*Mavromoustakis*) (BMNH); 1 ♀, 1 ♂,

Kilani, Krios R., 12.ix.1937 (♀) and 1.x.1937 (♂) (*Mavromoustakis*) (BMNH); ♀, Limassol, 26.v.1934 (*Mavromoustakis*) (BMNH); ♂, Pera Pedi, 19.ix.1937 (*Mavromoustakis*) (BMNH). **France:** ♀, Var, 8 km south of St. Tropez, 2.ix.1986 (*Bouček*) (BMNH). **Great Britain:** 9 ♀, 1 ♂ Berkshire, Silwood Park, em. 26.vi.1968 (♀), 28.vi.1968 (♀) and 30.vi.1968 (♀) ex *Spilomena enslini* in *Rubus* stem, em. 29.vi.1968 (♀) ex *Spilomena troglodytes* in *Sambucus* stem trap nest, em. 30.vi.1966 (♀), 4.vii.1966 (♀), 24.vi.1968 (♀), 26.vi.1968 (♀) and 26.vi.1966 (♂) ex *Spilomena* sp. in *Rubus* stem and em. 28.vi.1968 (♀), ex *Spilomena enslini* in *Rubus* stem (*Danks*) (BMNH); 2 ♀ Berkshire, Emmer Green, SU718773, 26.vi.1995 and 31.vii.1995 (*Notton*) (REDMG); 2 ♀, 2 ♂ Cambridgeshire, Chippenham Fen, TL6569, coll. 9.v.1995, em. 29.v.1995 (2 ♀), coll. 9.v.1995, em. date unknown (2 ♂) ex *Spilomena differens* in dead *Rhamnus catharticus* poles (*Shaw*) (NMS); 8 ♀, 1 ♂ Cambridgeshire, Chippenham Fen, TL650693, Malaise trap, carr at edge of reed bed, 6–13.vii.1983 (♀), 8–21.viii.1983 (♂), 29.vi–9.vii.1984 (♀), 15–27.viii.1984 (2 ♀), 27.viii–27.ix.1984 (3 ♀) and 25.vi–9.vii.1985 (♀) (*Field*) (NMS); ♀ Devon, Torquay district, viii.1929 (*Nixon*) (BMNH); ♂ Hampshire, New Forest, Brockenhurst, 7.vii.1985 (*Bouček*) (BMNH); 2 ♀ Hampshire, West Wood, west of Winchester, coll. 3.ii.1985, em. (forced) 8.iii.1985, ex *Spilomena* sp. in *Rubus* stems (*Else*) (NMS); 2 ♀ Middlesex, Bedford Park, vi.1928 and 17.vii.1929 (*Waterston*) (BMNH); ♀ Oxfordshire, Taynton Fen, SP233148, Malaise trap, 7–28.vii.1989 (*Porter*) (NMS); 2 ♀, 1 ♂ Surrey, Albury Downs, em. 17.vi.1967 (♀) and em. 20.vi.1967 (♂) ex *S. enslini* in *Rubus* stem and em. 26.vi.1968 (♀) ex *Spilomena* sp. in *Rubus* stem (*Danks*) (BMNH); 2 ♂ Surrey, Leatherhead, em. 24.vi.1967 ex *S. troglodytes* in *Rubus* stem and em. 21.vi.1967 ex *Spilomena* sp. in *Rubus* stem (*Danks*) (BMNH); 2 ♂ Surrey, Newlands Corner, em. 23.vi.1967 ex *S. enslini* in *Rubus* stem and em. 20.vi.1967 ex *Spilomena* sp. in *Rubus* stem (*Danks*) (BMNH); ♀ Surrey, Surbiton, em. 24.vi.1968 ex *Spilomena* sp. in *Buddleia* stem (*Danks*) (BMNH); ♀ Sussex, Wadhurst, 4.ix.1981 (*Dicker*) (BMNH).

**DISTRIBUTION.** During this study material was seen from Austria, Cyprus, France and Great Britain, and the species is newly recorded from Austria and France. There are published records from much of Europe and also from the East Palaearctic, including Cyprus: (Fitton, 1984); Czech Republic (Šedivý, 1989); Finland (Blüthgen, 1953); Germany (Ruschka, 1922; Schmiedeknecht, 1930; Blüthgen, 1953; Horstmann, 1968); Hungary (Bajari, 1960); Italy (Scaramozzino, 1989); the Netherlands (Blüthgen, 1953; van Achter-

berg, 1976); Poland (Sawoniewicz, 1978, 1982 and 1986); Russia, including European area, St. Petersburg and the far East, Sakhalin (Tobias, 1963; Kasparyan, 1995); Spain (Rey del Castillo, 1991) and Great Britain and Ireland (Waterston, 1929; Stelfox, 1950; Danks, 1971; Fitton, 1984; Boston, 1986).

**BIOLOGY.** Danks (1971) provides the most detailed account of the biology of *N. enslini* to date: it has been recorded as a parasitoid of *Spilomena* species, and has been presumed to be a larval endoparasitoid. It overwinters in the host nest, presumably as a prepupa in its strongly constructed cocoon. *N. enslini* has been recorded during April to October but most often from June to September, suggesting plurivoltinism although clear evidence on the number of generations per year is lacking. Danks' (1971) rearings do not throw any light on this as he reared it mostly from nests collected in winter which would have been attacked the previous summer. It is not clear how many generations per year the host *Spilomena* species have: Danks (1971) speculates that *Spilomena* are bivoltine and Yarrow (1969) and Richards (1980) also note that some species have long seasons in Britain, from May to September, suggesting plurivoltinism. Previously recorded hosts of *N. enslini* include *S. enslini* Blüthgen and *S. troglodytes* (Vander Linden) (Hym., Sphecidae) nesting in many kinds of stems (Ruschka, 1922; Danks, 1971; Short, 1978; Kasparyan, 1981 & 1995). Although *Rubus fruticosus* (agg.) stems are the most commonly recorded substrate this is probably a sampling artifact as *Rubus* stems are much easier to collect and rear insects from than more massive dead wood. *N. enslini* will certainly attack hosts in more substantial substrates and it is recorded here from *Spilomena differens* Blüthgen in standing dead *Rhamnus catharticus* poles of about 3 cm in diameter. Since the species of *Spilomena* are notoriously difficult to identify (Blüthgen, 1953; Horstmann, 1968; Yarrow, 1969) and their taxonomy is still in a state of flux (Archer, M., pers. com.) published host records should be regarded with caution and new rearings should be investigated with care, expressing an appropriate amount of doubt as to the identification of the host, although it seems likely that *N. enslini* will prove to attack all *Spilomena* species in the region.

**COMMENTS.** The apical antennal segment occasionally shows traces of a suture indicating that it is derived from the fusion of at least two segments; however this suture is virtually never complete and, of all the material examined above, in only one female was the suture sufficiently complete on one antenna that it could be considered fourteen segmented. Otherwise thirteen-segmented antenna are the norm. The male genital capsule has been figured by Tobias (1963), the habitus of the mature larva by Danks (1971) and the head sclerites of the mature larva by Horstmann (1968), Short (1978) and most successfully by Danks (1971).



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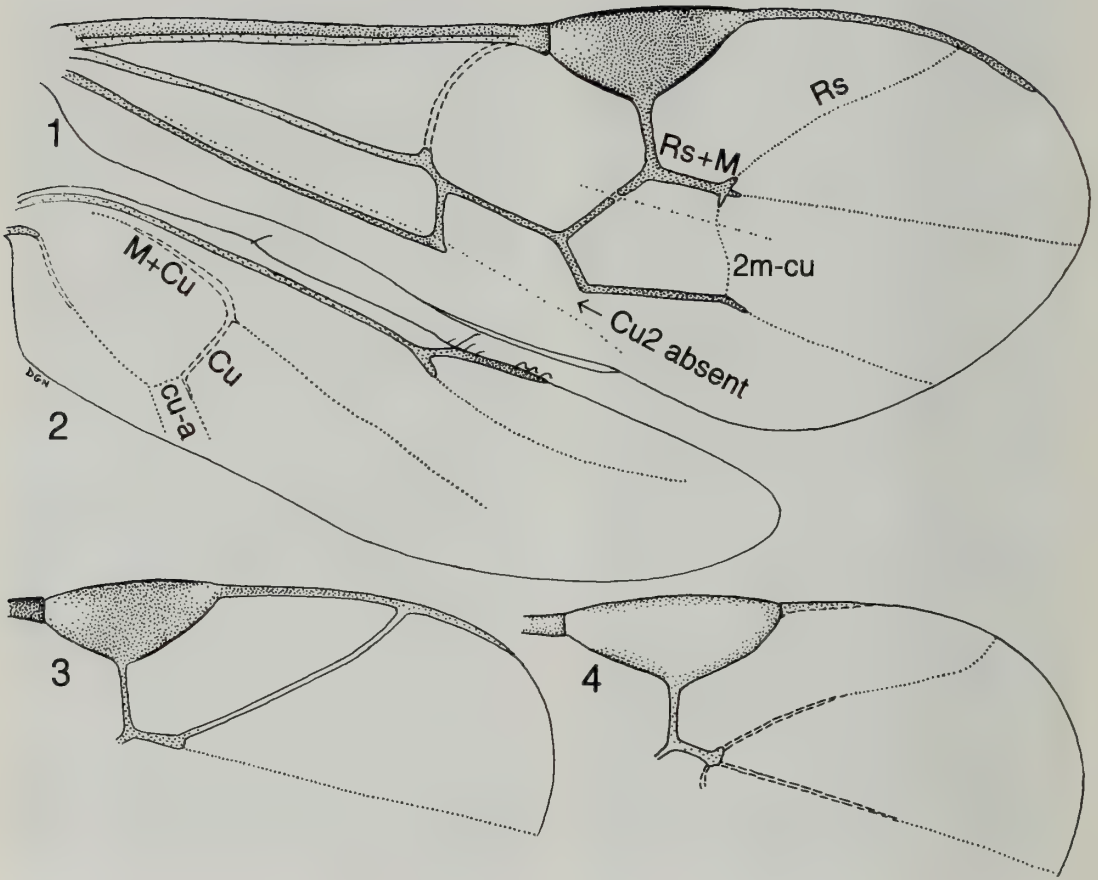
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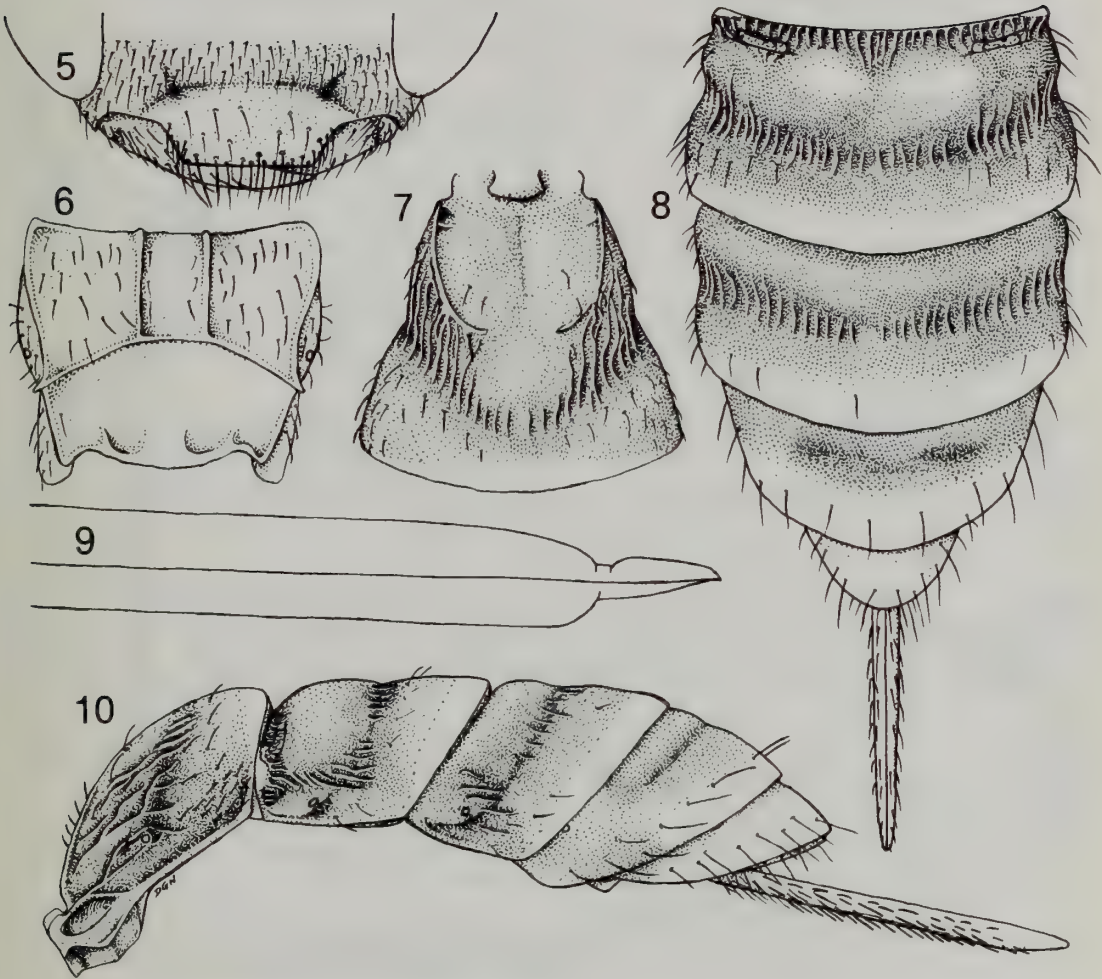
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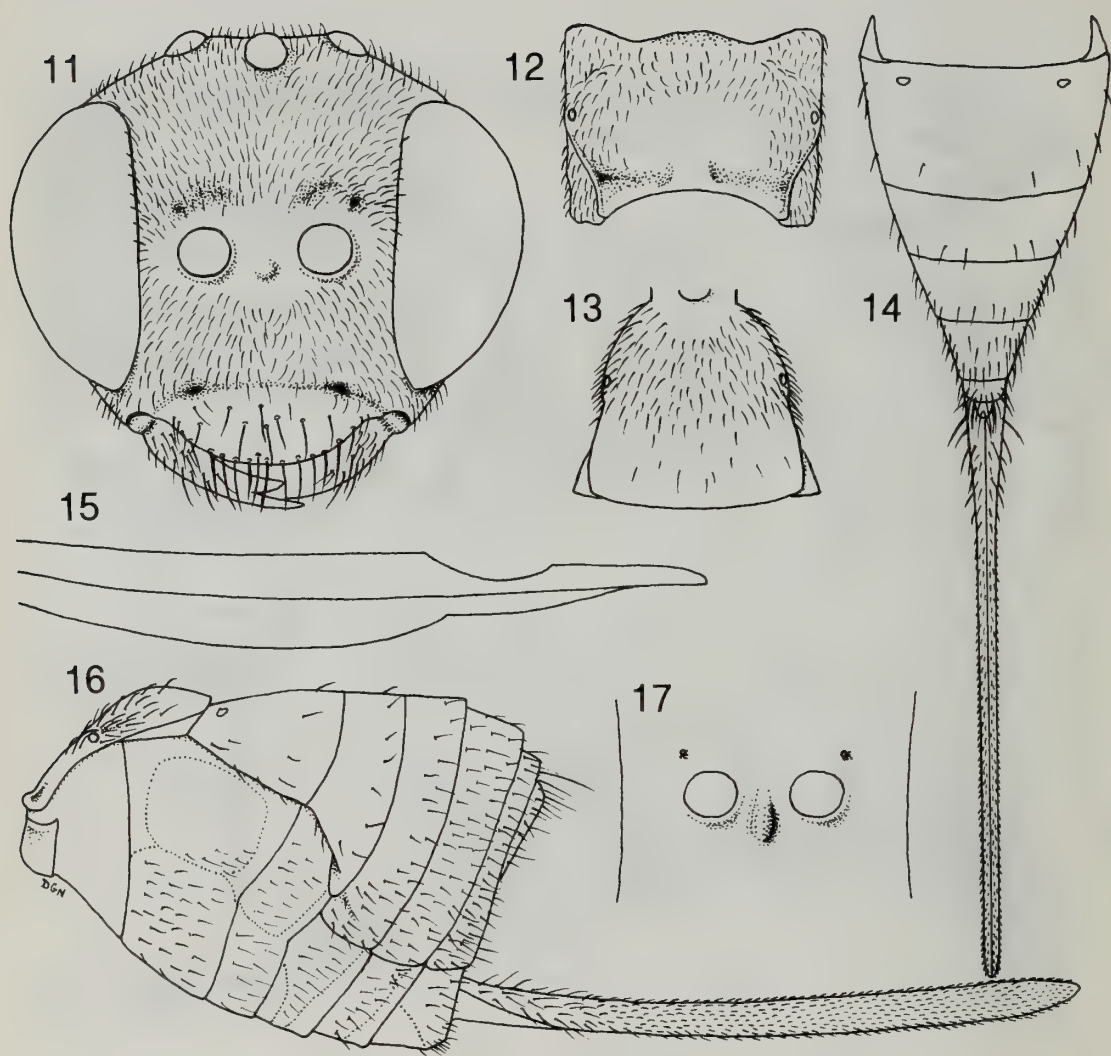




**Figs 1–2.** *Neorhacodes enslini* – 1, fore wing; 2, hind wing. **Fig. 3** *Eremura perepetshaenkoi* – fore wing (part), showing pterostigma and radial cell, holotype ♀. **Fig. 4** *E. turkmenica* – fore wing (part), showing pterostigma and radial cell, paratype ♀.



**Figs 5–10.** *Neorhacodes enslini* – 5, lower face, clypeus and mandibles, anterior; 6, propodeum, dorsal; 7, metasomal tergite one, dorsal; 8, metasomal tergites two and beyond, dorsal; 9, ovipositor tip, lateral; 10, metasoma, lateral.



**Figs 11–16.** *Eremura perepetshaenkoi* – 11, head, anterior, holotype ♀; 12, propodeum, dorsal; 13, metasomal tergite one, dorsal; 14, metasomal tergites two and beyond, dorsal; 15, ovipositor tip, lateral; 16, metasoma, lateral, holotype ♀. **Fig. 17** *E. turkmenica* – head (part), anterior, showing position of toruli, paratype ♀.



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